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Popular Science

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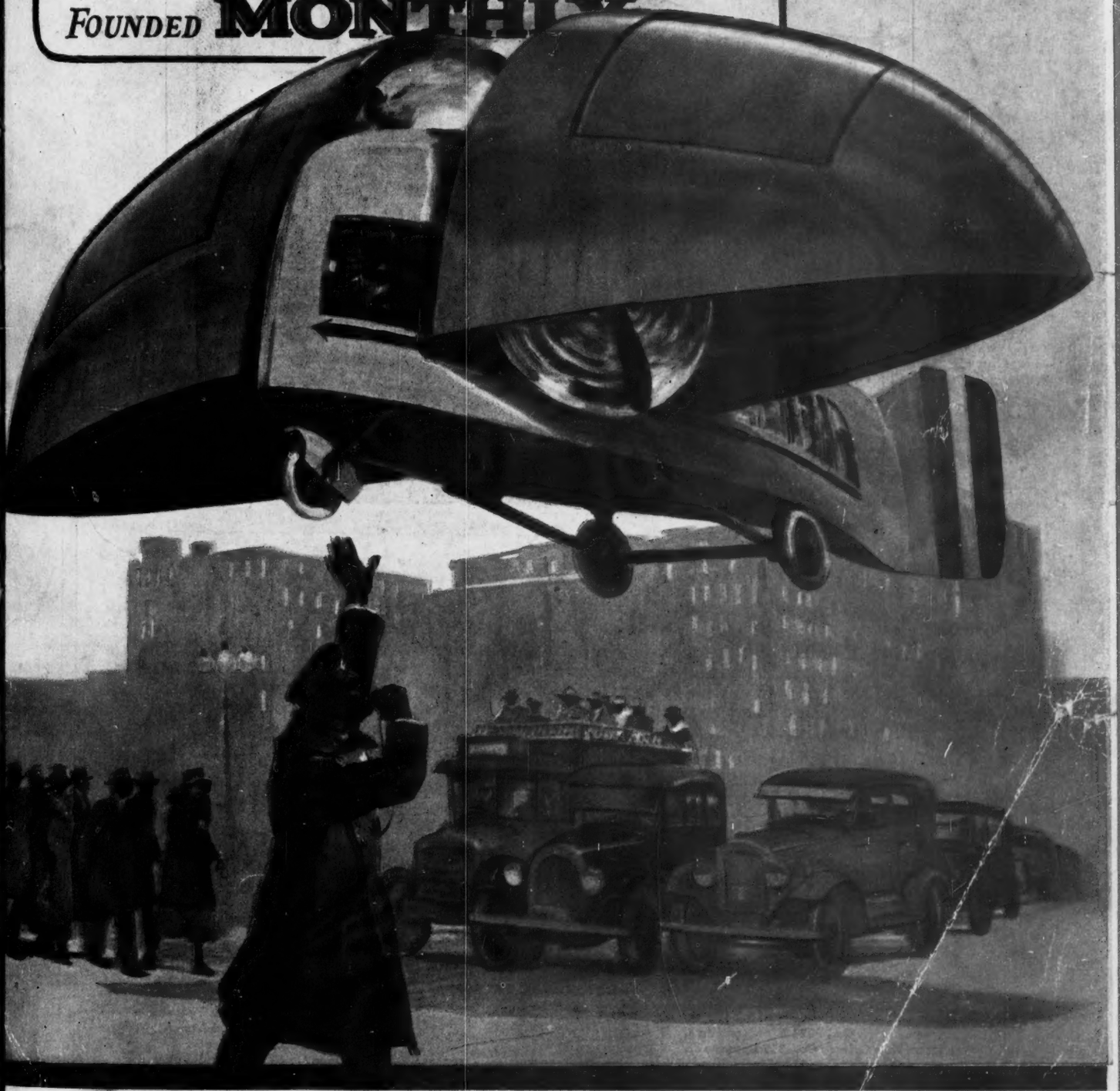

Radical New Steps in Aviation (See page 34)

EBRUARY *Most Wonderfully Illustrated Magazine in the World* 25 CENTS

Stirring the Fires of Youthful Ambition

REMEMBER, back in boyhood days, how *you* envied the leader of the Hometown Band and longed to play his flashing Cornet! The same ambitions are stirring the hearts of Young America today.

Conn is helping to realize those ambitions, developing not only musical talent, but a spirit of teamwork which comes with playing in a band or orchestra, and all the qualities of sturdy young manhood. For playing a Conn instrument is wholesome fun, healthful exercise, and an excellent character-builder as well.

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POPULAR SCIENCE MONTHLY

Most Wonderfully Illustrated Magazine in the World

FEBRUARY, 1924; Vol. 104, No. 2
25 cents a Copy; $2.50 a Year

Published in New York City at
225 West Thirty-ninth Street

FROM Seattle comes an interesting query: "For some time I have been working on an idea that I believe will lead to an important scientific discovery. But I am discouraged because my friends give me the laugh. Is it worth while to keep on trying?"

The writer says his investigations show the world has a real use for his product and that it can be manufactured at a reasonable cost. And, he adds, he has the mental equipment to see his idea through.

* *

IS IT worth while to keep on trying? Turn to page 31 of this issue. Read Mr. Francis Jehl's story of Edison. People, scientists of repute and his friends, jeered at his idea of an incandescent lamp. And even as they jeered he was lighting his little workshop with his lamps. Today the world that jeered cheers at the mention of his name.

* *

REMEMBER Robert Fulton. He and his steamboat were the butt of countless jokes. A widely known British marine engineer "proved" by mathematics that the idea of running a boat by steam, independent of wind, was "preposterous." But before the ink was dry on his published article, a steamboat had landed in England. The laughter of skeptics infused zest into Fulton's task, and it was he who had the last laugh.

In Next Month's Issue

My Fellow Scientist—The Rat—The fascinating story of how a scientific investigator, by experimenting with rats, discovered valuable new facts about diet and its relation to health and longer life.

Private Conversations by Radio — A glimpse at approaching marvels of radio communication, as forecast by Jack Binns, America's foremost writer on radio subjects.

Mechanics in the Jungles — The startling adventures of Capt. Frank Hurley, noted British explorer, whose knowledge of mechanics proved an invaluable aid in the wilds of New Guinea.

Your Headlights and Your Safety — Simple tricks of adjustment that will insure your car against disaster in night driving.

Success in the Backyard Garden — An expert's timely suggestions for planning, planting, and growing the summer crop of vegetables.

And 200 other fascinating articles and pictures

SCIENTIFIC achievement and inventive accomplishment frequently mean the ability to face derision. It is human nature to oppose that which we do not understand. Worry over the sneers of the heedless only wastes the spirit's substance. Such worry only increases your problems and leaves you weaker to handle them. Refuse to heed such taunts and they will cease to annoy you.

* *

A POOR inventor once waited for four hours outside the office of Commodore Vanderbilt, the railroad magnate. He had an invention he wanted to sell for $10,000. Finally Vanderbilt said: "Tell that man I have no time to waste on fools." The inventor was George Westinghouse. His invention was the airbrake. Such a rebuff might have chilled the heart of a weakling. But Westinghouse believed in his idea. And, it is said, Vanderbilt's sneer only forced him into grips with his problem, the conquest of which brought him millions.

* *

IF YOU are sure of your idea, have the curiosity to find out about things and the energy to overcome obstacles. It is always worth while to keep on trying. Concentrate all of yourself on a worthy purpose. Don't be too modest. Close your ears to jeers and say to yourself—IT CAN BE DONE!

POPULAR SCIENCE MONTHLY

Issued monthly. *Single copy, 25 cents. Yearly subscription to United States, its possessions, and Canada, $2.50; foreign countries, $3.*

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H. J. Fisher, *President;* R. C. Wilson, *Vice-President*
O. B. Capen, *Secretary and Treasurer*

The WANDERING MINSTREL of TODAY

HOW far have we progressed from the days when the minstrels, singing their self-composed ballads to the accompaniment of harp or lute, or telling their stories illustrated with crude mimicry, wandered from castle to castle in old England furnishing to the nobility practically the only entertainment available.

To-day every American, no matter how far removed from the centers of activity has within his reach up-to-the-minute news and amusements that would have delighted the hearts of the nobility of old. The air is filled with merriment waiting to be captured and brought to your very fire-side.

Radio is the magic wand that attracts to you the desired entertainment. Crosley Radio Receivers are the instruments by which this entertainment may be clearly and distinctly converted into a true reproduction of the original voice thousands of miles away.

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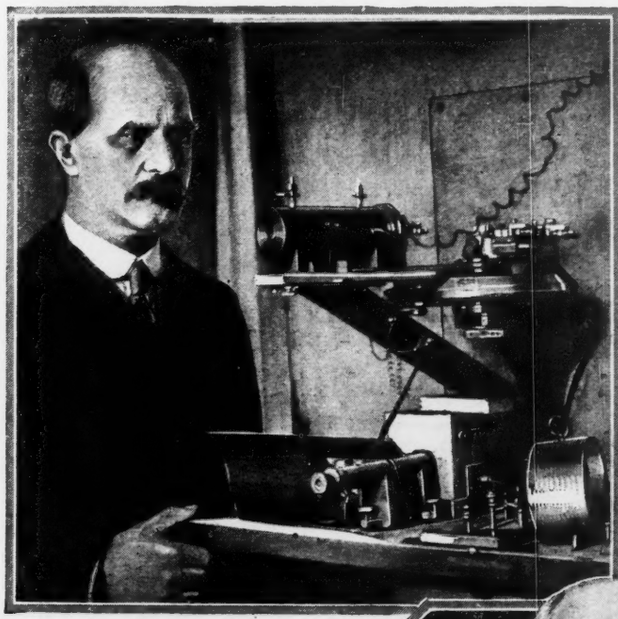
Men of the Hour in Science



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SIR WILLIAM BRAGG, one of England's leading scientists, at work in his laboratory at University College, London, with his wonderful instrument called the "X-ray spectrometer," by means of which he is attempting to fathom the secrets of the mighty, infinitesimal atom. He is one of the world's scientists who, through researches into the construction and action of atoms, are revolutionizing the study of physics, making it possible to study the nature of the universe from the smallest particles of matter

FRIDTJOF NANSEN, D.Sc., D.C.L., Ph.D., F.R.G.S., world-famous Norwegian arctic explorer, author, educator, scientist, diplomat, and winner of the Nobel peace prize in 1922. He now is a leader in organized effort to rehabilitate the war-devastated nations of Europe, and in this interest recently visited the United States on a lecture tour

CHARLES GREELEY ABBOT, D.Sc., astrophysicist of the Smithsonian Institute, Washington, D. C. With the aid of a giant, 100-inch reflector at the Mount Wilson observatory, California, he has succeeded in measuring the heat of stars to the hundred millionth of a degree. Doctor Abbot is shown above with a sensitive heat-measuring instrument called the "pyrheliometer," which he invented for his researches. It is based on the same principle as the little black-and-silver vanes, revolved by light, often seen in opticians' windows

DR. LEANDER TOMARKIN, a young Swiss biologist, recently announced the discovery of a cure for pneumonia. He calls his remedy "antimicrobum," a chemical compound that is said to have reduced pneumonia mortality from 35 to 2 per cent. He is shown below in his laboratory at the Holy Ghost Hospital in Rome, where he is reported to be testing a remedy for tuberculosis

Dr. Leander Tomarkin

J. WALTER FEWKES, Ph.D., LL.D., director of the Bureau of American Ethnology, Smithsonian Institute, Washington, D. C. He has contributed largely to our scientific knowledge of the races of men that have inhabited the American continent, especially the Hopi Indians and Cliff Dwellers. He is shown below examining a piece of bread more than 500 years old, dug from Indian ruins

Dr. J. Walter Fewkes

SAMUEL WESLEY STRATTON, B.S., D.Sc., new president of the Massachusetts Institute of Technology, and for 21 years director of the United States Bureau of Standards, declared, in a recent statement, that "there is a great and growing need for men trained in methods of investigation as applied to the industries," and that "we need men skilled in physics and chemistry, who can appreciate problems that are to come with industrial progress." On the engineer and scientific investigator, he said, depends largely the commercial and industrial progress of the United States

"The coming of a friend from a far-off land—is this not true joy?" Confucius—

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POPULAR SCIENCE MONTHLY
SUMNER N. BLOSSOM, Editor
February, 1924

Edison, the Man

An Old Friend's Intimate Recollections of the Great Inventor

By Francis Jehl

FORTY-FIVE years ago, Francis Jehl, then 18 years old, went to work for Thomas A. Edison as a laboratory assistant. Mr. Edison at that time was experimenting with the incandescent lamp and had a staff of seven men. Mr. Jehl is the only survivor of that staff, the only man living except Mr. Edison who saw the birth and development of the lights we all use today.

Mr. Jehl has been in the Edison organization since the day in 1879 when he was chased into Mr. Edison's office by a pet bear the great inventor kept in the yard of the lamp works. He now is connected with the Edison Museum in New York City. He has been in constant touch with America's greatest inventor for nearly half a century, and knows his chief as few other men are privileged to know him.

YOU probably read in the newspaper the other day that Thomas A. Edison had sent for an old Michigan fiddler, Jep Bisbee, to come East so that phonograph records might be made of the jig tunes he had played for Edison, Henry Ford, and Harvey Firestone when they were on their camping tour last summer.

For me there was a great deal more in that story than the papers printed. That Edison had not forgotten a promise made half a year ago to a casual acquaintance of his vacation jaunt who wanted to hear his tunes on a phonograph, told me that he still remains the same great-hearted, considerate, thoughtful man he was 45 years ago, when I started working for him as a lad of 18 in his historic laboratory at Menlo Park, N. J.

We read so much of Edison as the electrical wizard and the world's greatest inventive genius, that most of us, I fear, have lost sight of the fact that he is a human being as well—a broad-minded, sympathetic, kindly man who reads the newspapers to see what his fellow men are doing, who enjoys a clever joke and a good cigar, and who derives as much wholesome fun out of life as any man alive.

A Thoughtful Man

That little incident of the old Michigan fiddler is typical of the Edison I know, the man who always is looking out for others and trying to make them happy. It brought to my mind the memory of my first meeting with him and the surprise I got to find him the very opposite of the cold, austere scientist I had pictured him.

I had been reading law at the office of Grosvenor P. Lowery, counsel for the Western Union Telegraph Company. He noticed that my principal interest lay in briefs concerning electrical patents. One day he asked me about this, and I admitted that I was more interested in electricity than in law. Mr Lowery knew Thomas Edison as the inventor of the stock ticker, the quadruple telegraph, and other devices bought from him by the Western Union. He was convinced of Edison's genius and had been quietly enlisting the financial backing of such men as J. Pierpont Morgan, E. G. Fabbri, Robert F. Cutting, and Henry Villard for Edison in the latter's experiments on a new type of electric lamp. He gave me a letter to Edison, and one day I took a train to Menlo Park to present it.

Menlo Park, then as now, was an obscure little hamlet on the Pennsylvania Railroad, a few miles from Rahway, N. J. People who have traveled on Pennsylvania trains between New York and Philadelphia doubtless have seen the station as they whizzed past. The main street was all but deserted that day as I hurried toward the long, white-painted, two-story frame house that was Edison's laboratory.

I was thrilled, and more than a little awed. I was about to see the greatest inventor in the world! More than that, Mr. Lowery had told me that Edison was agreeable to my joining his laboratory force, if I could qualify. You can imagine how my heart was thumping; how I was besieged by fears and misgivings as to the sort of impression I might make on Mr. Edison.

An unusual portrait of the great inventor as he appears today

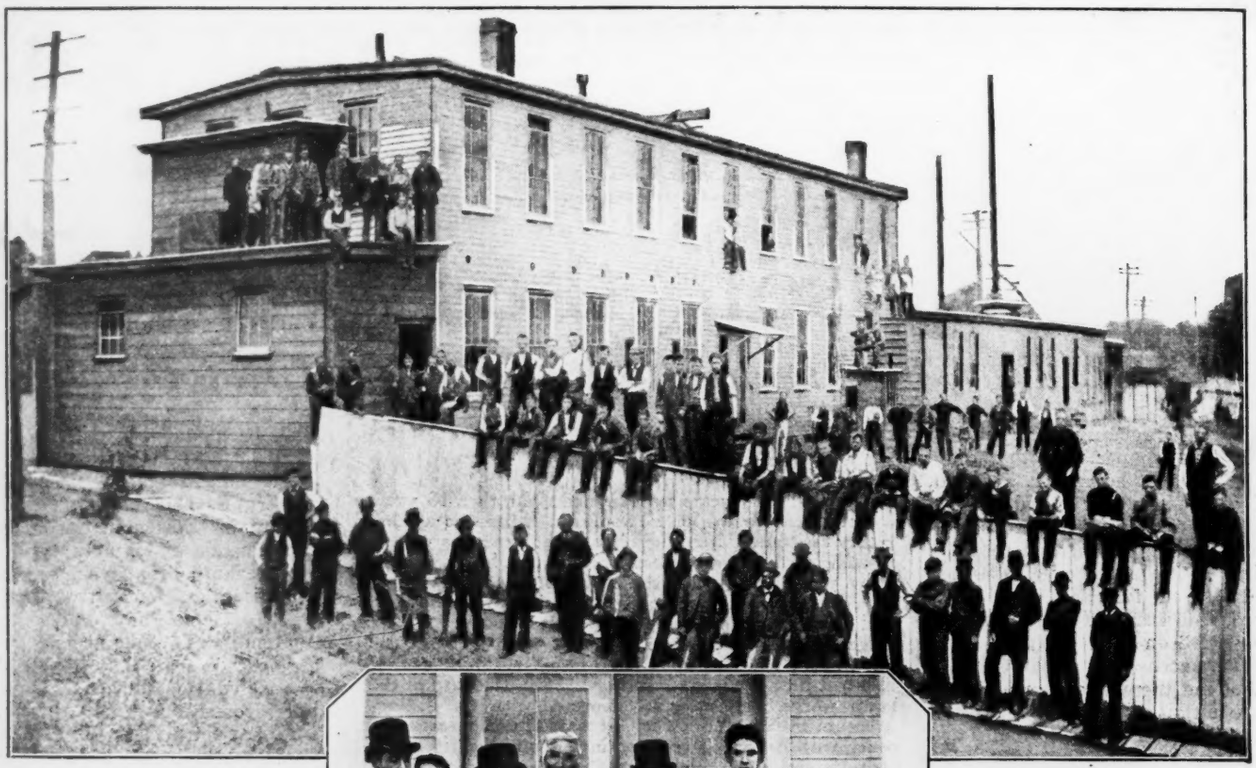
Edison's "Pet Dog"

As I approached the front porch I caught sight of a great shaggy mass lying under a giant hickory tree beside the house.

"Ah!" I thought. "Mr. Edison's pet dog!"

It occurred to me that I might win some slight favor with Mr. Edison if I could make friends with his dog, so I thrust out my hand to pat the animal. The next instant I was rushing up the stairs of the laboratory, the worst scared young man who ever had entered the place. For the animal under the tree was a brown bear. It was chained there; but I didn't take time to ascertain that fact. I just ran.

I forgot all my carefully rehearsed speeches, forgot everything I had planned to impress Mr. Edison. I



The historic laboratory and lamp factory at Menlo Park, N. J., where in 1879 Edison and his assistants manufactured the first incandescent lamps in the world

Here, 45 years ago, the writer of this article, then a lad of 18, went to work for Edison and took part in his early struggles for recognition and commercial success

A group picture of Edison surrounded by members of his family and his laboratory assistants, taken in 1879. Beside him are his two children, Marion and Thomas, Jr.—nicknamed "Dot" and "Dash." The white-haired man is Samuel Edison, the inventor's father. Francis Jehl, author of this article, is the third man from the left in the top row

dashed into his laboratory, panting and dishevelled, looking apprehensively behind me for the beast which I felt must be at my heels. I had intended to be dignified. Instead, I was funny and, I fear, ridiculous.

Mr. Edison laughed heartily when I burst in on him, but it was a laugh that endeared him to me forever—a sudden, swift revelation of his character. There was no ridicule in the laugh; no trace of enjoyment of a boy's embarrassment. It was just a wholesome, hearty, spontaneous burst of merriment such as any comical happening might cause.

"Well, son," he said, "did the bear chase you in? Don't let that bother you—you're not the first one."

In an instant I was at my ease, and within a very few minutes arrangements had been made for me to join Mr. Edison, an association that has continued without interruption to the present day.

Six others besides myself were at the laboratory, aiding Edison in his experiments with the incandescent lamp. He was entering his thirties then—an earnest young man with a determined, purposeful face, crowned with that same mop of hair that is silvery now. We worked. Mr. Edison had a faculty for getting things done and for keeping his force inspired with the same enthusiasm that actuated him. Yet not one of us ever thought of him as "the boss." For he was no driver. He had—and has—executive ability—a faculty for handling men in a degree possessed by no other man I ever have met.

Sometimes it would take half a day to mount a filament in a lamp—and then it wouldn't work. The man who had done the work often would be discouraged to such a point that he was ready to give it all up—to leave the development of the incandescent lamp to somebody else with hardihood enough to continue such unsatisfactory work indefinitely. That mood, though, never lasted long when Mr. Edison entered the scene. His eyes would twinkle as though the unsuccessful experiment were just a joke.

"Well, now," he'd say, "we'd better try that again. Maybe this time we'll find out what's wrong with it."

And that's the way the incandescent lamp was invented—experiment after experiment; tireless search for the reason for failure; attempts to correct mistakes. And always the indomitable spirit of Edison triumphed over setbacks and discouragements, inspiring his assistants with faith in his purposes and confidence in his ultimate success.

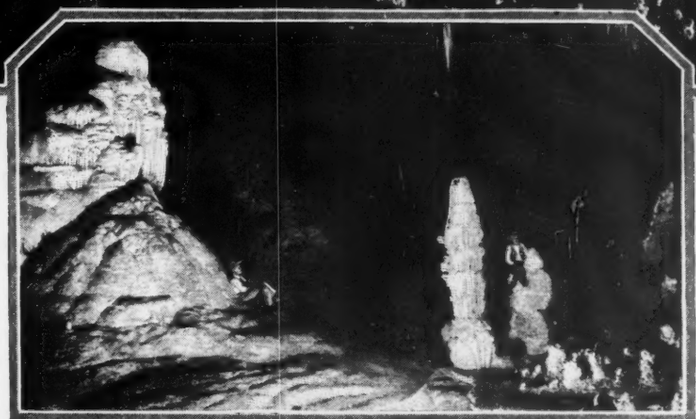
You have read that Edison is a tireless worker. No man ever worked harder and more relentlessly than he did in those early days. And by the magic of his personality he kept us all working with him, heedless of discomfort or fatigue, interested only in the work we were doing, and reluctant to leave it until it was done. Night after night we stayed at the laboratory until the gray light of the new day drifted in through the windows. Mr. Edison would toss a few books on a bench or

(*Continued on page 140*)

The Edison of 1879, described by the writer as "an earnest young man, with a determined, purposeful face"

Exploring World's Greatest Cavern

One of the great chambers of the Carlsbad Cave, shown above, is more than half a mile long. Columns range from the length of a needle to heights greater than 100 feet. The ceiling is more than 300 feet high



Except for millions of bats, the great Carlsbad Cave shelters no animal nor vegetable life. In the early morning and late afternoon the echoing darkness is vibrant with the beating of their wings as they dart among the grotesque formations

The slow seep and drip of mineral solution through incalculable ages shaped the weird architecture shown below. Drips from the vaulted ceilings built up the dark stalagmite rising like a pillar in the foreground, and the stalactites that hang from the ceilings like huge icicles

Below are shown two massive columns rising to a height of 70 feet above the floor of the cavern. They are dark green in color. Unusual formations of smaller stalagmites, ranging in color from light cream to dark brown, are shown at the left center

WITH fantastically beautiful rock formations and cathedral-like chambers glittering in a hundred shades of color, this vast cavern near Carlsbad, New Mexico, is believed to be the largest ever discovered. Although its existence had been known since 1901, when swarms of bats were seen to fly from a hole in the side of a hill, it was only recently that its interior was explored by scientists of the United States Geological Survey.

A small party, headed by Dr. Willis T. Lee, entered the lofty chambers while seeking to discover why waters impounded in dams along the Pecos River disappeared underground. One of the enormous rooms was found to be half a mile long and a quarter mile wide.

How the Followplane, gigantic seaplane cruiser to be constructed at Cleveland, Ohio, will appear when completed. This drawing is based on the designers' plans. The giant liner will be 170 feet long, and will be designed to carry 100 passengers and 2½ tons of express freight

Whole World in Race for Supremacy in the Air

By Donald Harris

THE swiftly moving airplane of today, with its one or two specially trained occupants, soon may share its dominance of the air with the slower-moving commercial liners and the more versatile helicopters of tomorrow, just as the specially constructed racing automobiles of 20 years ago moved over to give road room to the utilitarian cars of today.

Epochal Advances in Aviation

Epochal advances in aviation are in progress. The air flivver already is here. The helicopter and the gigantic air cruiser for freight and passengers are on the way.

In France recently M. Oehmichen flew for nine minutes in a helicopter designed by him, rising 35 feet and circling a course. This set a record in vertical flight, more than trebling the best previous feat. A few weeks later, in another type of helicopter, the Marquis Pescara accomplished a flight of nearly six minutes. Throughout France helicopter development is receiving the enthusiastic attention of the most eminent aeronautical designers.

In England and Germany, tiny planes analogous to low-priced automobiles enjoy the focus of expert attention.

In the United States, birthplace of the airplane, giant planes, such as the army's Barling bomber, and great dirigibles, such as the navy's *Shenandoah*, have become the goal of our most distinguished designers.

Among the latest developments in these countries, remarkable are the Halley helicopter in France, shown on the cover of this issue, and the gigantic Followplane aerial cruiser to be constructed in the United States, the design of which is shown in the drawing at the top of these pages.

The new helicopter designed by Charles Halley, a noted French engineer, conceivably may revolutionize aeronautical design. Although this machine exists only as a model, the radical yet apparently sound departures embodied in it have engaged the keen attention of experts everywhere. A successful helicopter would obviate the need for flying fields. Helicopter hangars on office-building roofs would make it possible for business men to commute 100 miles by air and to land the distance of an elevator ride from their offices.

On the Halley machine two bell-shaped wings are attached to a car resembling an airplane fuselage. Two motors in this car drive two propellers revolving in a vertical plane on each side, drawing air from above the machine and driving it against the curved under surfaces of the wings.

By deflecting the air downward, the wings exert an upward push. Combined with the suction obtained by drawing air from above, this push is said to raise the craft swiftly and vertically.

Tilting the wings ejects the air from the propellers rearward as well as downward. This, the inventor claims, produces sufficient force both to keep the craft aloft and to drive it forward.

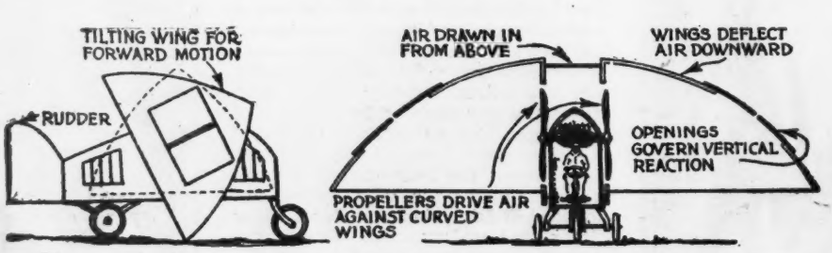
Directed by Controlled Air Currents

In addition to the steering lever, there is a vertical control lever that opens and closes openings in the center of each curved wing. When these holes are opened, part of the air driven against the wings will escape, lessening the vertical propulsion.

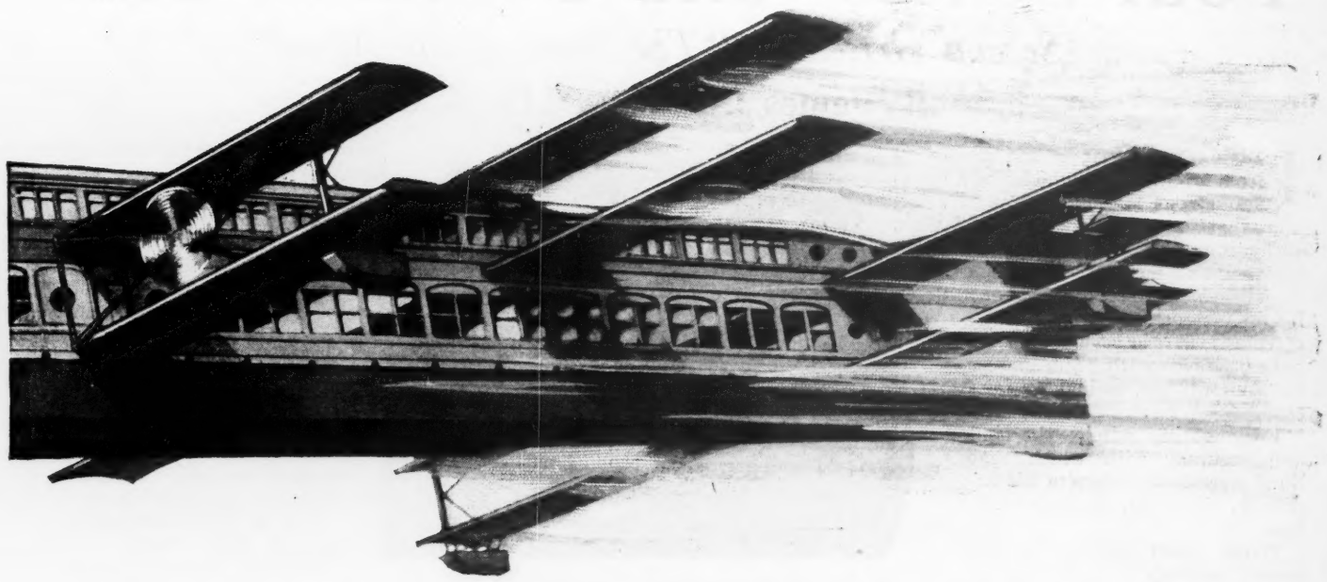
A wider opening is said to cause the machine to hover, practically motionless. And, finally, a still wider opening, the inventor claims, will cause the machine to descend.

It is claimed also that the parachute shape of the wings makes the Halley helicopter comparatively safe, even if the motor should fail.

The huge Followplane air cruiser, designs of which were completed recently by Thomas R. McMechin, once a Zeppelin engineer, and Lt. Arthur Dennison, for-


TILTING WING FOR FORWARD MOTION
RUDDER
AIR DRAWN IN FROM ABOVE
WINGS DEFLECT AIR DOWNWARD
OPENINGS GOVERN VERTICAL REACTION
PROPELLERS DRIVE AIR AGAINST CURVED WINGS

Diagrammatic views, side and rear, of the revolutionary parachute-like helicopter designed by Charles Halley, French engineer, and pictured on the cover of this issue. Its principle consists of drawing air from above and driving it against the wings to produce upward motion



mer United States Army designer, truly is a remarkable machine.

This gigantic freight and passenger plane, by far the largest ever seriously projected, is to be built at Cleveland, Ohio. It is to be all of metal, 170 feet long, 26 feet from keel to top. It will contain 2500 square feet of floor space and will fly with six staggered pairs of wings, each with a span of 61 feet. Six engines, of 900 horsepower each, will drive six propellers. These engines will be paired, only two operating at the normal cruising speed of 125 miles. The other four will be reserves. It is estimated that a speed of 200 miles an hour could be attained with all six engines operating.

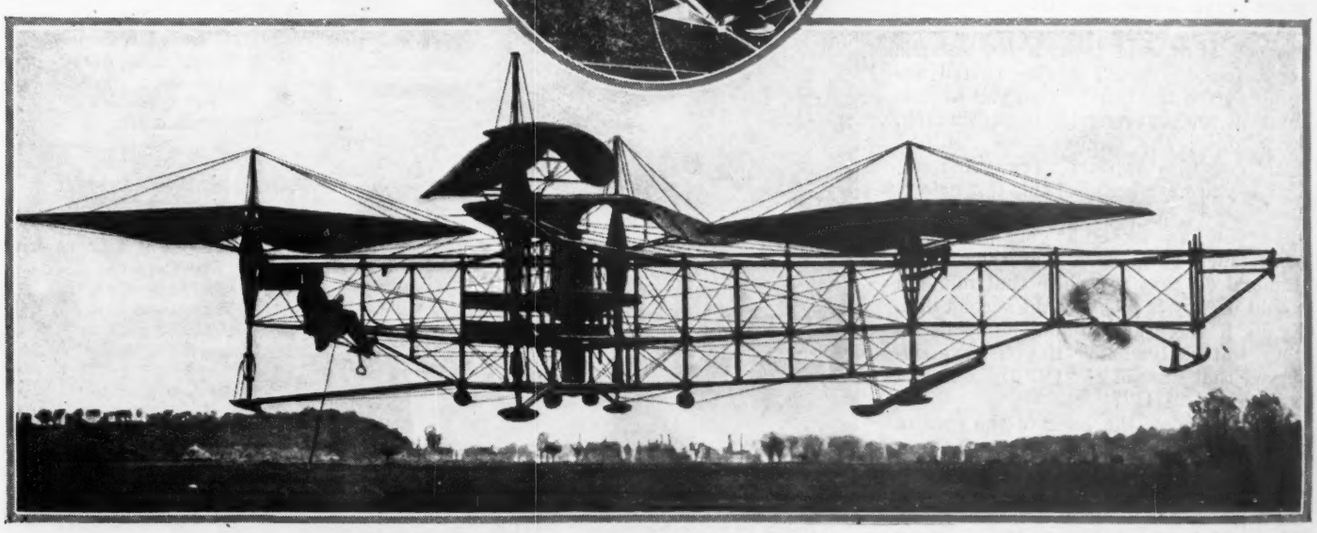
This aerial giant will be a seaplane, capable of rising from and landing on water. The great length of the wings and their staggered arrangement, combined with the weight of the plane, is expected to allow the machine to travel through severe weather with no more than a very slow roll. All combustible supplies will be carried in an airtight compartment, which can be flooded instantly with carbon dioxid in event of fire.

The engines embody numerous radical departures in internal combustion design. They will burn fuel oil, a feature that is expected to reduce their operating cost. It is claimed further that they cannot backfire. Power is transmitted to the propellers through a hydraulic system.

When completed, the great air liner is expected to shorten the traveling distance from New York to London to less than 24 hours, at the normal cruising speed of 125 miles. An American statesman could leave Washington one afternoon and keep a speaking engagement in London the next evening. Chicago and New York would be only six hours apart. It is estimated that a $35 fare would make the craft pay a profit on this route. For the transatlantic journey, a fare less than $150 would be adequate, it is believed. At least 100 passengers and 2½ tons of express freight could be carried.

Staterooms with berths will make night travel feasible, and dining accommodations will be provided. Passengers will not need to remain in their seats throughout the journey, as in small passenger planes. Even dancing space could be provided, the designers say. Because of the all-metal construction and fireproof compartments, smoking can be allowed.

The Halley helicopter and the Followplane both represent new mile posts in man's swift conquest of the air. Other aerial models await only the working out of constructional details.



The new helicopter invented and operated by M. Oehmichen, shown in flight during a recent trial near Valentigney, France. The machine rose 35 feet on a circular course, remaining in the air for nine minutes, breaking all previous records for vertical flight. The inset shows the inventor at the controls

Your Senses—and Common Sense

Second Article in "The Story of the Mind"

By James J. Walsh, M.D., Sc.D.

I BUY my newspapers and magazines from a blind man, who keeps a newsstand near my home. When I tell him what papers and periodicals I wish, without hesitating he selects them from the rack and hands them to me. He always makes correct change for me instantly from a pocketful of coins. In the several years I have been patronizing him I never have known him to make a mistake.

I cannot but admire the skill and accuracy with which that blind newsdealer, despite his infirmity, carries on his little business.

People often explain the apparent mystery of it by saying that nature has compensated him for his loss of sight by sharpening his other senses, especially his hearing and touch. But that is not true.

Bereft of sight and hearing since childhood, Helen Keller (at the right) and Willeta Huggins, 17-year-old Chicago girl, have achieved distinction by developing the sense of touch to an amazing degree. They are shown above in conversation. Miss Keller "hears" by placing her finger tips on the girl's lips, while Willeta understands what Miss Keller says by placing the finger tips on her chest and sensing voice vibrations

Under test by the esthesiometer, an instrument for estimating delicacy of touch, a blind man is shown to be no more sensitive than the normal person. For example, the blind man is not at all superior in recognizing, as two separate sensations, two needle points that prick his skin at points very close together. He has learned, though, to pay attention to minute differences in feeling and to recognize them, and he knows through practice what he expects to feel. Thus he is able to differentiate unerringly the pennies, nickels, dimes, and quarters in his pocket, and the magazines and newspapers on his stand; things which all of us could do quite as well if only we would concentrate on using our senses as they should be used.

How We Neglect Our Senses

Neglect of the unused resources of our senses is one of the great handicaps we place upon ourselves. Have you ever taken your watch from your pocket, glanced at it, and then, a few seconds later, found yourself unable to tell another person the time? Can you at this moment, without referring to your watch, write down the numerals on the dial exactly as they appear? Try it and see. Unless you have heard of this test before, I venture to say that in the thousands of times you have looked at your watch you have failed to observe that there is no numeral *6;* that the place that numeral would occupy is filled by the second dial. Again, if there are Roman numerals on your watch, I wonder if you have observed that instead of "IV" the numeral is inscribed "IIII"?

Do you know the color of the eyes of the person who sits beside you in your office or stands next to you in your shop? Can you tell with what words the government marks the value of a 25-cent piece, or on which side of the coin they appear?

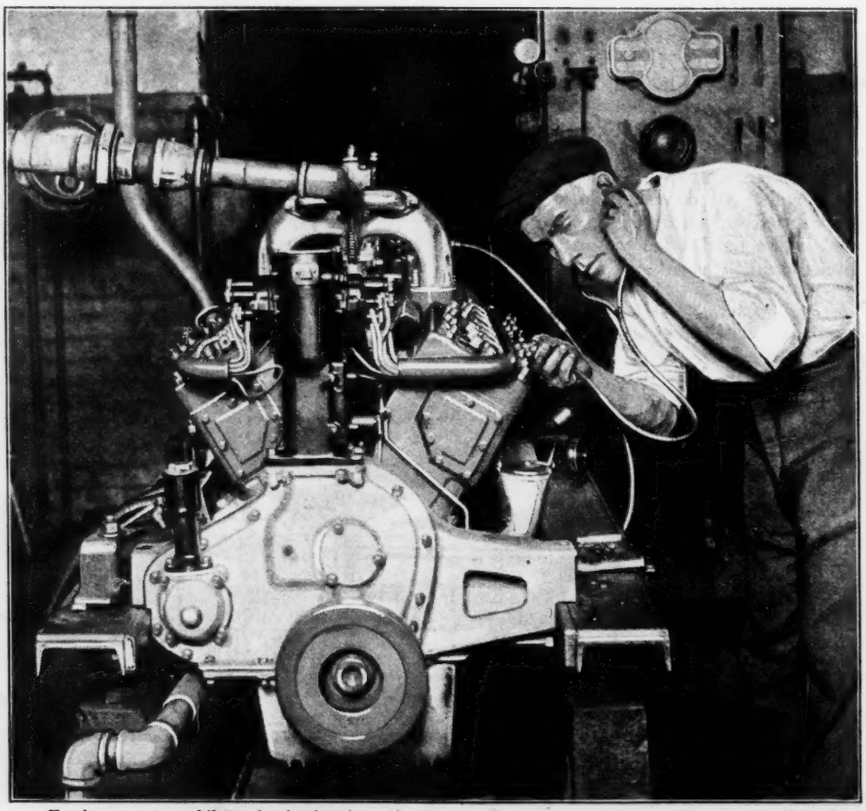
These are things that you have had hundreds of chances to observe. You may say they are not important; yet observing them in a way that would imprint them indelibly on your memory is a process that requires no effort if you have trained your senses to work for you as Nature intended they should. Such training in observation is an invaluable aid to successful achievement.

If you have not trained your senses to record accurately every impression they receive, you have placed an insurmountable barrier before the storehouse of your mind. For the senses are the gateways of knowledge; the only entrances by which the mind can receive the stimuli, without which, as I pointed out in the previous chapter of this series, the mind will not work.

Only through impressions received by your senses can your brain store up the facts and information that mean skill at your trade, expertness at your profession, scholarship in education, a trained mind for life.

The oldtime philosophers had a maxim well worth recalling: "There is nothing in the mind except what was beforehand in the senses." What they wanted to emphasize was that we are not born with ideas. We have instincts designed to enable us to live, and reflexes intended to protect us against dangers in early life; but we have no ideas. They have to be acquired.

It would be mighty handy for some of us if we could inherit the education of our parents, and, beginning with that basis, add more. Dr. Oliver Wendell Holmes praised Emerson as the seventh generation of an academic family, yet that hereditary quality did not add to Emer-



Testing an automobile engine in the plant of a Detroit automobile company. By concentrated training of his sense of hearing, the skilled mechanic who makes the tests has learned to detect the least flaw simply by listening to the sounds of the running engine through a stethoscope

son's possibility of mental development, much less confer education on him at birth. His environment, undoubtedly facilitated his education, but his heredity did not.

Your father and mother both may have known Greek well, or mathematics; but that will not make it any easier for you to learn either mathematics or Greek. On the other hand, your ancestors may have been uneducated drawers of water, hewers of wood, or tillers of the soil for many generations; yet it is possible for you to make ducks and drakes of the scion of an academic family who chances to start his education at the same time you do.

Tea tasters employed to grade imported teas and for the collection of customs duties, require a highly developed sense of taste. They command high salaries accordingly

In other words, what you know, what you learn, what you eventually amount to, are a result of what you yourself acquire through your senses. Hence, the necessity for training the senses.

In early life the untrained senses are almost useless. The child reaches out to grasp the moon because its senses have not yet been trained to perceive that, though the moon is very bright, it is too far away to be touched.

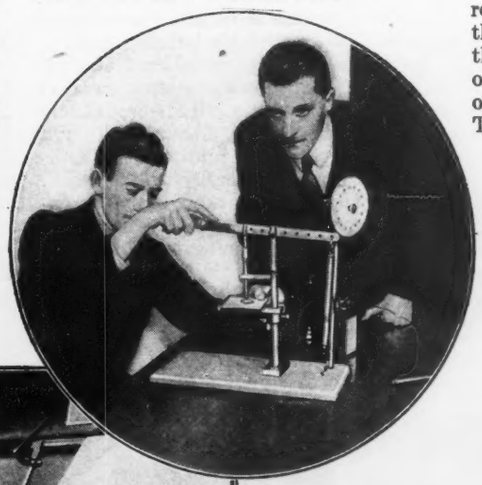
The Chinese Train Their Senses

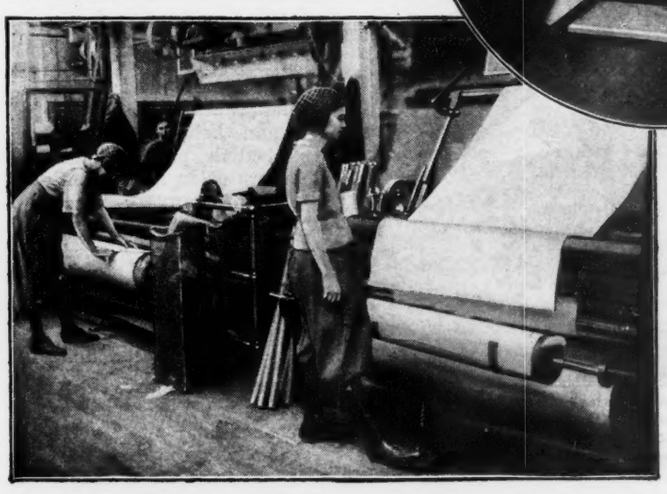
A little later in life this same child, as a result of experience and training of the senses, may be able, with one glance at a skyscraper, to tell you how high it is within a foot or so. They say that when a Chinese carpenter is summoned to make repairs, he looks at what has to be done, then goes back to his shop and cuts the boards so that they will fit exactly into the portion that is to be repaired. He has trained his sense of sight to give him exact knowledge.

I know a real-estate man who can go through a large building and tell you, when he comes out, the exact size of the rooms and how they are situated. An exceptional man? Not at all. He merely has trained his senses to perceive things accurately, and his memory to retain whatever they taught.

Go into a telegraph office and listen to the busy clatter of the receiving instruments. It all seems a meaningless jumble of sounds to you, yet the operators sitting beside the instruments are ticking off on their typewriters the meaning of those sounds in ordinary English at the rate of more than 100 words a minute.

Can they hear any better than the rest of us? Not at all. On the contrary, their hearing often is worse than the average, because the constant effort is a strain on the delicate hearing apparatus. They merely have trained their sense of hearing to catch the meaning of those sounds. After all, this is no different from learning a foreign language.





Above: A psychological test in judgment of space variations for the young man who is to enter an engineering shop

At the left: Inspecting finished artificial leather as it comes from the coating machinery in a factory at Newburgh, N. Y. The trained vision of the girl inspector detects the smallest flaw in the moving sheet of the fabric

When the telegraph was invented, a cumbrous printing apparatus for recording the signals went with it. This was extremely slow in operation. An enterprising telegrapher trained his sense of hearing until he could recognize the difference between the sounds of dots and dashes and those made by the machine, and thus read the message correctly.

Concentration

It proved an important discovery and trebled the value of the telegraph at once because it permitted messages to be exchanged three times as rapidly as before. This is the sort of thing that concentrated attention to any sense will achieve.

There is a very credible story of a country storekeeper who was able to tell the different solid colors—at least so far as red and blue and white and black were concerned—by touching the cloth. It seems almost impossible that such delicacy of touch could be acquired, yet there are considerations that make us appreciate exactly how it is done.

If you were to take small squares of red, blue, white, and black cloth of the same weight and material and spread them out on a windowsill over a freshly fallen layer of snow, with the sun shining on them, the snow beneath the four different colored squares would melt in varying times. The black cloth would be the first to touch the windowsill. The reason for this is that black absorbs all the rays of the sun and reflects none; therefore it takes up more heat than the other colors. White reflects all the rays of the sun and not a little of the heat. That is why light-colored clothes are more suitable than dark clothes for wear in the summertime and in tropical countries. Red absorbs more light and heat than blue.

Can You Feel Color?

The storekeeper had learned to differentiate among the four colors of cloth by the differences in temperature which they acquired from their varying power of absorbing and reflecting heat. It required extreme concentration of attention to accomplish his purpose, but then concentration is the only key that will unlock the gateways of knowledge that lead to the mind through our senses.

What that man did, you yourself have done many times in less degree; but, because you can see, because the necessity for further development of your sense of feeling did not impel you, you failed to acquire the excessive refinement of sense that made this merchant's feat seem so remarkable.

Groping in your desk in the dark, for example, you never would mistake for an ordinary pencil a hollow tube of metal, shaped like a pencil and

possibly of the same weight. The metal feels distinctly colder than the wood of an ordinary pencil. Similarly, you would recognize, at the first touch, the difference between a conventional pencil and a patent metallic pencil. You can tell at once whether an object is of metal or of wood, of stone or of composition, by the difference presented to your sense of touch.

Important though your eyes undoubtedly are, you do not depend on them if you wish to determine whether a column in a church is of stone or of some composition. You touch the column with the tips of your fingers and recognize almost at once the difference, through the intensity of the cold sensation presented to you. Of course, there is no actual difference in temperature.

Analyzing Touch Sense

If a pencil and a metal tube have been lying on your desk together for several hours, they are both of the same temperature—that is, the temperature of the room. But, since metal is a better conductor of heat than wood, the metal tube carries heat away from your hand faster and you note this fact at once. Hence the immediate recognition of the difference between them, though they may be of the same shape and weight and present exactly the same feeling of smoothness to the hand. The same thing is true of the pillar made of plaster and the pillar made of stone.

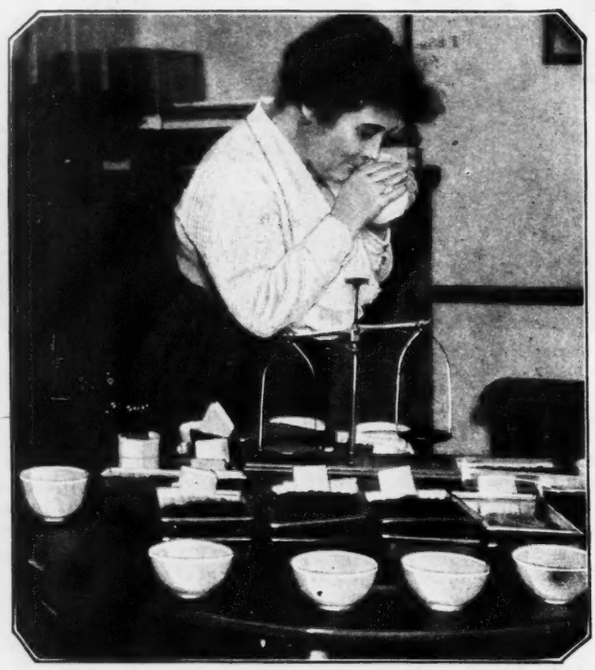
Nature has provided you with this wonderfully sensitive and versatile faculty of recognizing different objects through their different physical characteristics, merely by touching them. Such qualities as smoothness, shape, weight, and temperature transmit their individual messages to the touch. Doesn't this fact cause you to wonder whether what we call our sense of touch may not be actually several senses?

This is precisely the conclusion that psychologists have reached as a result of recent research. Instead of the five senses that long-established tradition credits to us, modern psychology says we have actually 25 or more, each independent of the other, each performing its own individual functions with regard to the assimilation of impressions which, when stored away in the mind, become knowledge.

Nerve Telephones

There are at least 25 different nerve endings that pick up information at the surfaces of the body and carry it to the brain, where it is registered. And each of those nerve endings will pick up only one kind of information for transmission and no other.

We have, for example, no less than six senses of touch. We have a sense for cold, another one for heat. We may lose one without losing the other. We have a sense of pain, too, which we may lose without losing our sense of contact. Some years ago I saw a man enter the Salpêtrière Hospital in Paris suffering from a badly burned finger and thumb. He had become engrossed in conversation with a friend and had permitted a lighted match to burn his fingers. He did not feel the burn, and was unaware of it until he smelled his burning flesh.



© U. & U.
Mrs. Alice Foote MacDougall, the only woman coffee grading and blending expert in America, at work in her office in New York City. Fifteen years ago Mrs. MacDougall was a penniless widow. Today she is at the head of a large retail and wholesale coffee business which she built up by her own efforts largely through training and developing her sense of smell

An affection of the spinal cord had cut off some of that man's sensory nerves on their way to the brain. Heat brought no sensation to his fingers, although he could distinguish cold, and could tell one familiar object from another by feeling them. His case supplied the most startling example I have encountered of the fact that we have at least a half dozen different senses of touch, each no more connected with the others than the eye nerves are connected with the hearing.

This discovery is of real practical value to us. It shows us that what we call our sense of touch, which we regard simply as a blunt purveyor of sensations, actually is capable of being trained to bring us the most delicate details of information and to serve as a highly useful auxiliary to what may seem the senses of sight and hearing.

The powers of the blind newsdealer I have mentioned illustrate vividly the really amazing possibilities that lie in full use of the sense of touch. Probably more remarkable still is the familiar case of Helen Keller, who, deprived of both sight and hearing by an attack of sickness in babyhood, and seemingly fated to remain a hopelessly ignorant and dependent human being, successfully completed a college course, won a doctorate of philosophy and has achieved distinction as a writer and lecturer. All of this she accomplished entirely by means of her sense—or senses—of touch.

Triumph over Blindness

Laura Bridgman, the young poetess of Buffalo, is another blind and deaf person who has triumphed over the cruelties of nature through training of the sense of touch. It will be remembered, too, that Homer, one of the first and greatest of the world's poets, undoubtedly was blind. So was the great Milton.

But the usefulness of the sense of touch is not confined to those who are deprived of other senses.

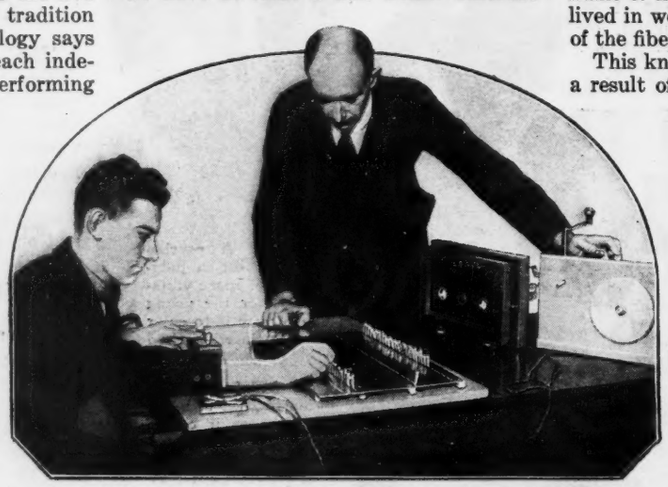
I know a cloth merchant who can tell the value of cloth to within a few cents a yard by feeling it. He can tell how many threads it contains to the inch. He knows instantly whether the material is pure wool or wool mixed with cotton; whether it is pure silk or one of the recently invented artificial silks; whether it is loaded with metallic salts that add apparently to the body of the material but make it likely to crack and to be short-lived in wearing. He knows the strength of the fiber, whether it is short or long.

This knowledge he has acquired only as a result of persistent training, for he entered the mercantile field as a clerk and had no previous experience in any other field. His sense of touch is no better than that of the average human being, but he has learned the priceless habit of concentration and attention.

Study Your Impressions

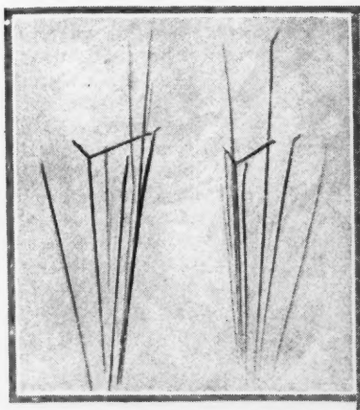
He has learned to interpret aright the impressions his senses of touch receive as he fingers a bit of cloth, and to remember those impressions so that he recognizes them instantly when he encounters them again.

(*Continued on page 145*)

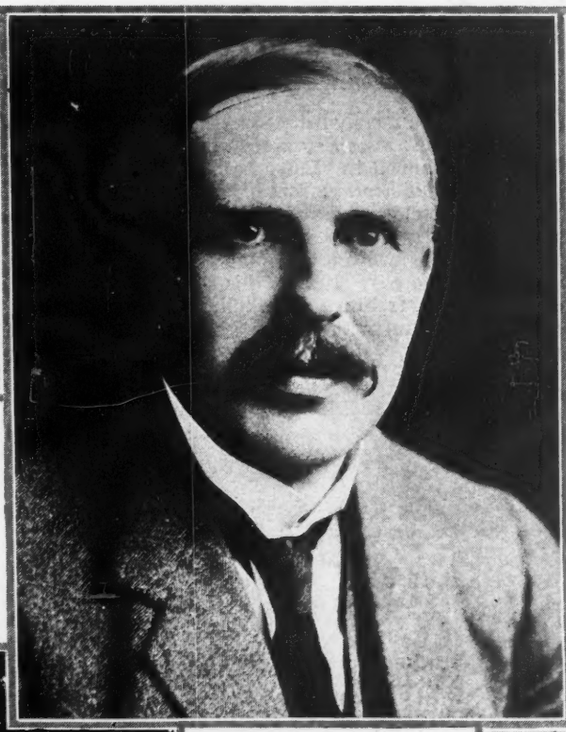


A psychological test to determine concentration and span of attention. The subject is required to concentrate on one job, at the same time giving attention to other details about him—in other words, to "attend to many things at once"—an important requirement for success

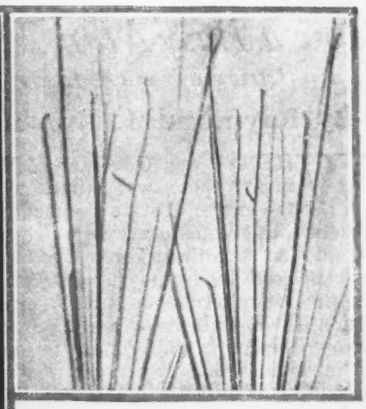
Amazing Photos of the Atomic Universe



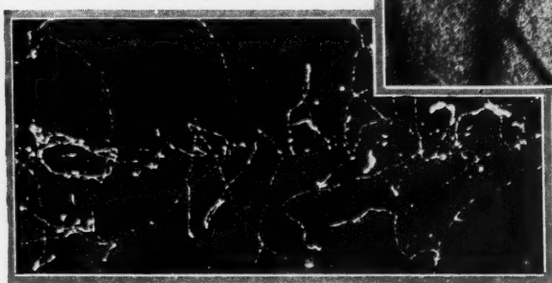
1. Two views of a collision of an alpha particle (helium) with an oxygen atom. The shorter fork shows the trail of the deflected atom. Science, exploring the world of the infinitely small, has found that an atom is a tiny solar system in which concentrated electric charges, called "electrons," revolve at a velocity of 93,000 miles a second about a central nucleus, as the planets about the sun



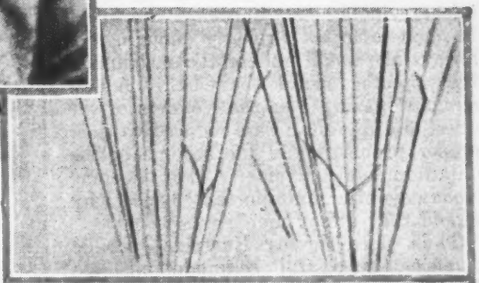
Sir Ernest Rutherford, F.R.S., president of the British Association for the Advancement of Science and one of the world's foremost authorities on radioactivity. In his experiments he plays with atoms as other men play with billiard balls. The amazing photographs reproduced here through his courtesy, illustrate his discoveries in a world invisible to ordinary microscopes



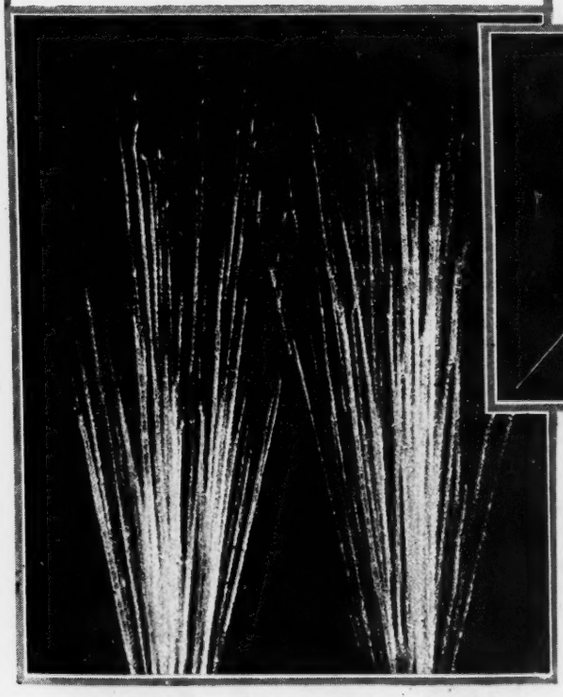
3. Two views showing collision of an alpha particle with a hydrogen nucleus. The left fork shows the track of the nucleus. Scientists say it would take a million times a million times a million hydrogen atoms to equal in size the smallest visible speck that can be weighed in a delicate chemical balance; yet here is an actual photograph of the movement of a portion of such an atom



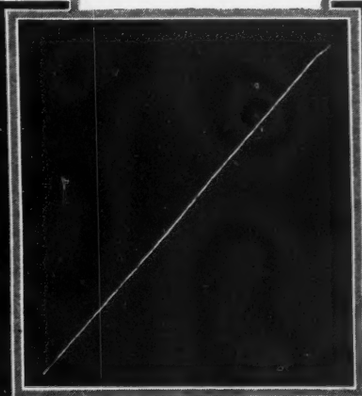
4. The passage of X-rays through the air. A narrow beam of X-rays liberates electrons from atoms of matter. In each atom there are from one to 92 of these tiny worlds



5. Two views of a collision between an alpha particle and a helium nucleus. Since both have the same mass, the deflection forks are equal



6. Alpha rays in the air from polonium, a radioactive substance discovered in 1898 by Madame Curie. These two spectacular photographs of mysterious radioactive emanations were taken at right angles to each other



2. Path of an alpha particle shot out from an atom of radium emanation. Rutherford's experiments have revealed that the rays given out by radium and kindred substances are of three different kinds—called "alpha, beta, and gamma rays"—and have proved that the alpha rays shot out by radium are none other than atoms of helium ga.

7. Collision of an electron with a nucleus of an atom and with other electrons—comparable with a collision between our world and the sun

8. A very weak X-ray, showing electrons liberated at an angle with its path. Although an atom is so small as to be almost incomprehensible to man, an electron is far smaller; yet it obeys orderly laws of the universe

By courtesy of Sir Ernest Rutherford, F.R.S. Photographs Nos. 1, 3, 5, and 6 by Mr. Blackett; Nos. 2, 4, 7, and 8 by Mr. C. T. R. Wilson

Astronomy from the Cellar

How a Busy Man Makes the Stars His Textbook

An Interview with James Hartness, ex-Governor of Vermont

By Raymond J. Brown

"WHEN I was Governor of Vermont, there were times when the affairs of state assumed proportions that seemed overwhelmingly important. At such times I would go to my telescope and look upon other worlds; then the affairs of men on earth, their intrigues, their ambitions, and their endeavors, became trivial. Then the seeming importance of this world, the states and nations of which are marked off by definite, narrow lines, paled into insignificance in comparison with the vast worlds that lie beyond us; worlds that have no boundaries; worlds whose infinite size we cannot comprehend.

Earth's Affairs Seem Insignificant

"Whenever my troubles get too much for me, whenever I begin thinking that I am carrying a heavy burden, I find solace in my telescope. Properly enough, it is always the small end of the instrument that points toward the earth. A few minutes' gazing into the wonders of the skies, and my affairs are reduced to their proper proportion in the scheme of the unfathomable universe. They become inconsequential, unimportant; hence, why should they annoy me?"

Thus does James Hartness—prolific inventor, successful selfmade business man, former governor of his state, recipient of honors for useful scientific achievement—describe the unique philosophy of life that has come to him from pursuit of his hobby of astronomical observation "from the human standpoint."

An Underground Observatory

Going underground to look at the heavens may seem like a strange anomaly; yet that is exactly what Mr. Hartness does. For on his big hillside estate at Springfield, Vt., he has constructed the strangest astronomical observatory in the world—a subterranean cave of concrete, containing a half-dozen rooms fitted up as laboratory, library, study, office, and retiring and storage rooms. Connecting with his home by a 200-foot tunnel, the cave ends with the observation chamber, a concrete structure from which juts a cast-iron revolving turret that holds his telescope.

In this turret, which is an adaptation of the revolving turret of a battleship, Mr. Hartness conducts his studies of other worlds. There he is shielded from interruption and from distraction by annoyances of the world in which he lives.

His observatory is little short of revolutionary from the standpoint of the orthodox astronomer. In fact, when his first rough plans were shown to astronomers and makers of optical instruments, they shook their heads gravely and assured him that it couldn't be done.

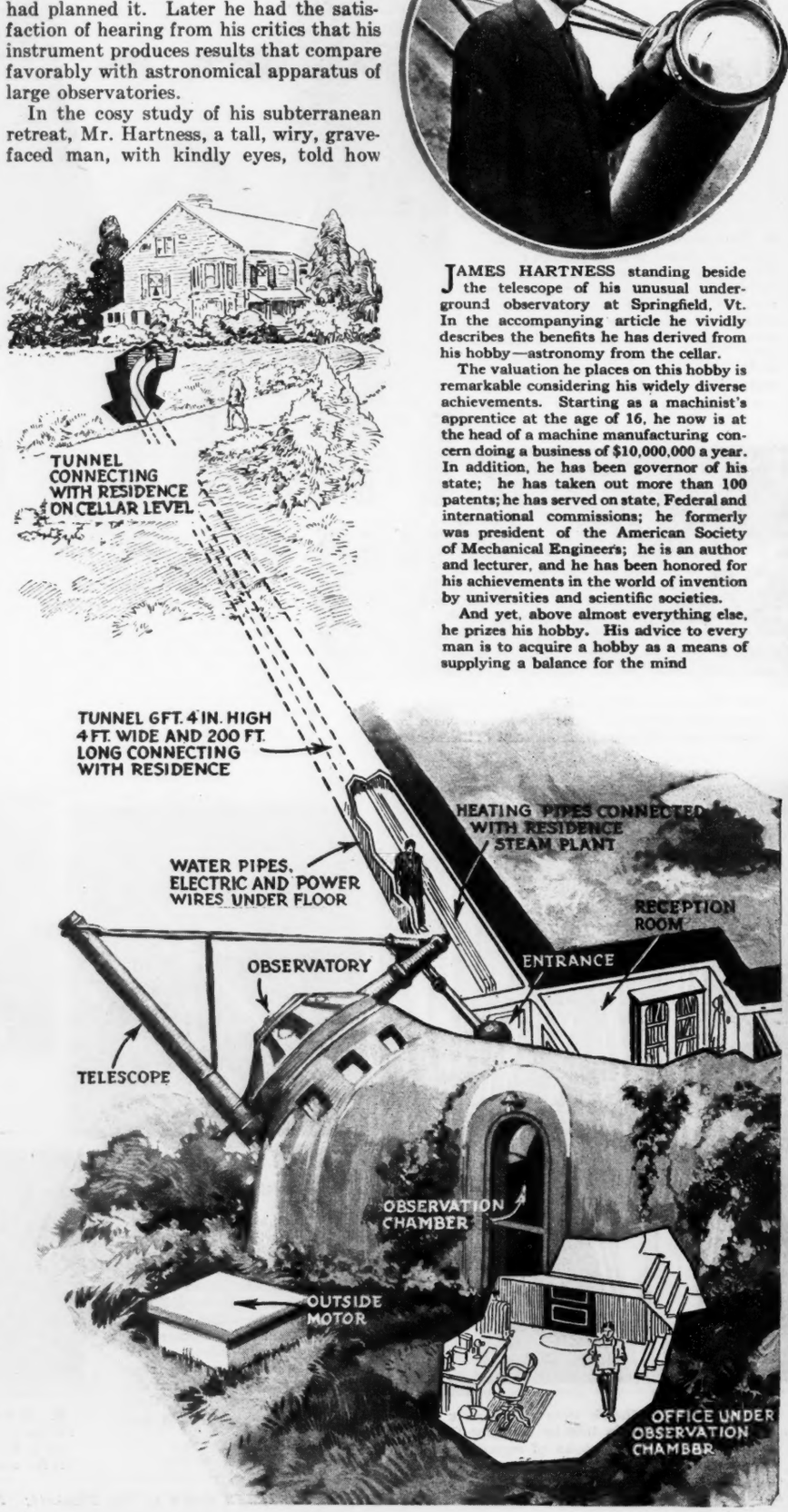
But Mr. Hartness, who had something more than 100 inventions to his credit at the time, merely listened to the objections and built his observatory virtually as he had planned it. Later he had the satisfaction of hearing from his critics that his instrument produces results that compare favorably with astronomical apparatus of large observatories.

In the cosy study of his subterranean retreat, Mr. Hartness, a tall, wiry, grave-faced man, with kindly eyes, told how

JAMES HARTNESS standing beside the telescope of his unusual underground observatory at Springfield, Vt. In the accompanying article he vividly describes the benefits he has derived from his hobby—astronomy from the cellar.

The valuation he places on this hobby is remarkable considering his widely diverse achievements. Starting as a machinist's apprentice at the age of 16, he now is at the head of a machine manufacturing concern doing a business of $10,000,000 a year. In addition, he has been governor of his state; he has taken out more than 100 patents; he has served on state, Federal and international commissions; he formerly was president of the American Society of Mechanical Engineers; he is an author and lecturer, and he has been honored for his achievements in the world of invention by universities and scientific societies.

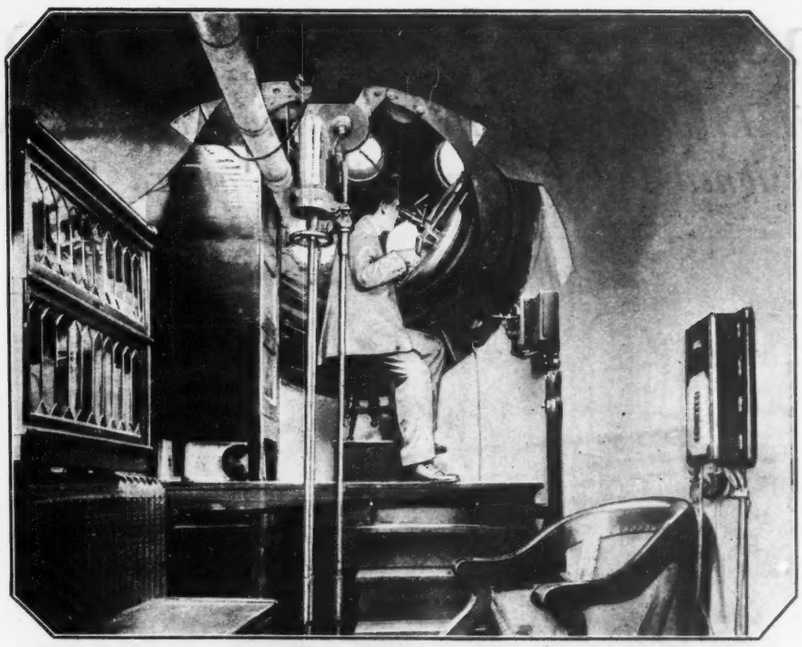
And yet, above almost everything else, he prizes his hobby. His advice to every man is to acquire a hobby as a means of supplying a balance for the mind


TUNNEL CONNECTING WITH RESIDENCE ON CELLAR LEVEL
TUNNEL 6 FT. 4 IN. HIGH 4 FT. WIDE AND 200 FT. LONG CONNECTING WITH RESIDENCE
HEATING PIPES CONNECTED WITH RESIDENCE STEAM PLANT
WATER PIPES, ELECTRIC AND POWER WIRES UNDER FLOOR
RECEPTION ROOM
ENTRANCE
OBSERVATORY
TELESCOPE
OBSERVATION CHAMBER
OUTSIDE MOTOR
OFFICE UNDER OBSERVATION CHAMBER

through astronomy—an accidental hobby with him—he found both happiness and a philosophy that helps to carry him over the rough places.

"Astronomy," he said, "has given me a better conception of where we are and where we are going. Probably I can make this plain by telling of a little incident that happened recently.

"A visitor to my home was telling me of a European trip from which he had just returned. Having been abroad many times myself, I naturally was interested, and offered a few experiences from my own travels. I fear both of us became somewhat boastful, as men often do when telling of the strange places they have visited in their lifetime.



Interior of the remarkable underground observatory, showing ex-Governor Hartness seated at his turret telescope. In this cavern chamber the observer is shielded from winter cold and from summer insects, as well as from interruption in his work

"My little granddaughter, who was in the room with us, seemed quite unimpressed by our talk. And at last, as my visitor finished a description of an odd little village in a remote section of the Alps, she suddenly exclaimed:

" 'That's nothing. Grandfather and I have seen *heaven!*'

"I could not bring myself to reprove her, because what she said was so close to the truth. We *had* seen heaven—many times, through my telescope. We had brought the celestial bodies close to us—or rather had approached a little nearer to them. We had seen with our own eyes what an infinitesimal mite of dust is the earth we live on, and how comparatively unimportant in the general scheme of things are the inhabitants of the earth and all their works.

"Consider Antares, the biggest star astronomers have measured. Its *diameter*—the distance across it—is 400,000,000 miles—more than four times the distance between the earth and the sun! Or take Betelgeuse, with a diameter of 242,000,000 miles. Why, if either of those stars were to find its way into our solar system, our earth and the other planets would be swept away before it as the wheat stalks fall beneath the reaper! And we of the earth consider our affairs important!

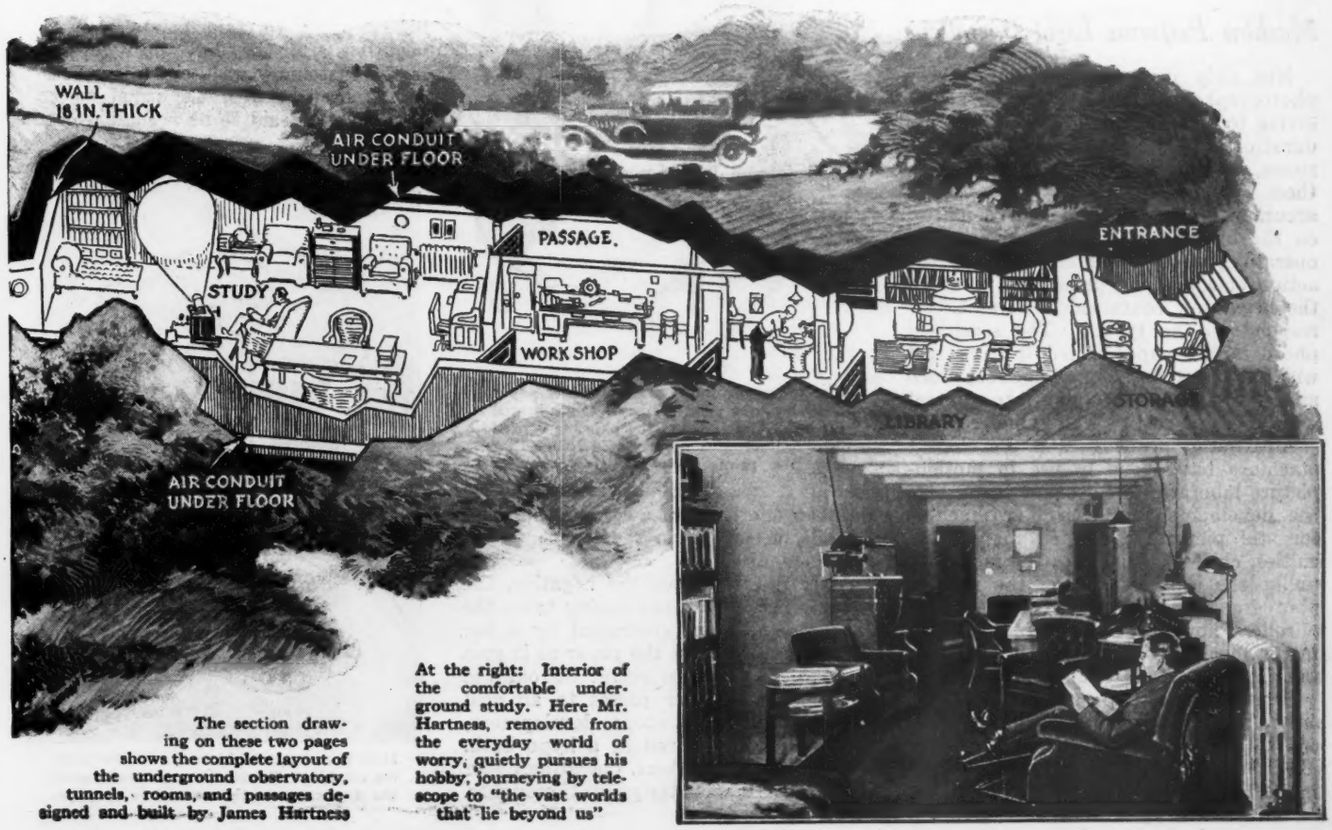
"That is what the child meant when she spoke of seeing heaven; and in the years in which I have pursued my astronomical observation hobby, no phrase that I have heard better describes its thrill and its usefulness.

"The bodies in the heavens that we see as mere pinpoints of light, actually are larger and more magnificent than our sun; and it is inconceivable that on those bodies or on other bodies revolving about them there are not intelligences vastly higher than ours; intelligences that may have solved in part even the mysteries that we on the earth strain to understand as we peer into the beyond through our futile instruments.

"That is a conviction that is bound to seize any one who spends some time on astronomy, not from the mathematical standpoint, but as a wholesome, human avocation, a way of stimulating the imagination.

"The units of measurement we employ on the earth—feet, yards, and miles—

(*Continued on page 147*)



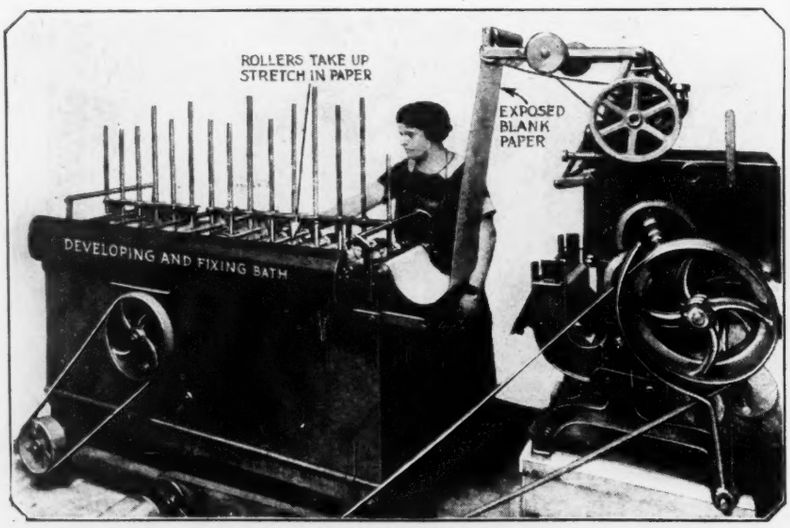
The section drawing on these two pages shows the complete layout of the underground observatory, tunnels, rooms, and passages designed and built by James Hartness

At the right: Interior of the comfortable underground study. Here Mr. Hartness, removed from the everyday world of worry, quietly pursues his hobby, journeying by telescope to "the vast worlds that lie beyond us"

Machine Prints 30,000 Photos Daily

Automatic Production of Finished Pictures from Negatives Designed to Give Rapid-Fire Camera Service

A HIGH speed photographic printing machine, which, in point of output, bears about the same relation to the ordinary method of printing that the printing press does to the pen, has been perfected by a Chicago manufacturer. Any one who has done photographic work or who has seen contact prints made probably can appreciate the amazing capacity of a machine that can produce 4000 finished prints in an hour —more than 30,000 in a day.



The new automatic developing machine, showing the exposed sheet of sensitized print paper passing from a roll in an endless sheet through compartments that develop, fix, and wash the prints. The paper moves over rollers that take up most of the stretch

Though designed primarily for commercial work, in the rapid-fire production of prints for photographic news services and similar enterprises, this machine, it is said, can be adapted quite readily to the uses of concerns doing developing and printing work for amateurs on a large scale. Combined with a suitable drying process for negatives, a machine of this sort would make it possible for amateurs to paste their pictures in the album a few hours after they had snapped their cameras.

Machine Performs Eight Operations

Not only does the machine expose photographic prints at remarkable speed, giving to each the varying intensity and duration of light required, but it develops, rinses,. fixes, and washes them, counts them out and sorts them with absolute accuracy, and prints descriptive matter on the backs. All this is a continuous operation, which resembles in a way the action of a printing press, and in which the negatives, contained in a frame, correspond to the type. The sensitized photographic paper is led into contact with the negatives from a huge roll, much as print paper is brought into contact with the type casting in a cylinder press.

Automatic printing and developing machines have been in use in motion-picture laboratories for some years, but, the development of a similar machine for still pictures presented many difficulties, chief of which was the fact that, unlike the celluloid film of the movies, photographic paper stretches. A series of rollers, however, has been incorporated in the machine to take up all stretch in the paper and hold it taut as it passes.

Prints of several negatives, of course, are made at one time. A lamp house, containing twelve 100-watt lamps, supplies the light, which may be adjusted in intensity and is automatically regulated between one tenth of a second and three seconds, according to the length of exposure required.

The drying machine. Here the wet paper containing the prints passes over gas-heated drums. After drying, the paper is carried into contact with silver-plated rollers that give the prints their fine glossy surface

After printing from the negative, the paper passes into a developing tank, the development being controlled by a bar that raises or lowers the paper as it goes through the bottom roller. From the developer the paper passes to an acid rinsing bath that stops development, after which it is fixed in a hypo bath. Next, six spray washers, operating under high pressure, wash the prints thoroughly. Then the paper is led into a hardening bath, rinsed again under forced spray and automatically wound up, all surplus water being removed by a powerful wringer.

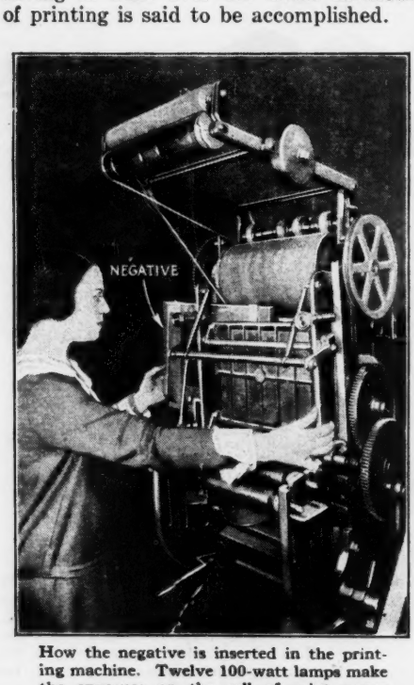
The roll of wet paper then is transferred to a drying machine, consisting of two gas-heated drums and three silver - plated, gas - heated rollers. The silver plating on the rollers produces a high gloss finish in the prints.

When the roll is dry, it is slit by hand into lengths of four feet, from which the separate prints are cut by a power cutter.

The machine is said to have proved efficient and practical in operation, and it is estimated that it can accomplish more work than 15 men.

The high-speed printing operation is conducted in rooms much more brightly illuminated than the ordinary photographic darkrooms. All work is done in a yellow diffused light.

Possibly it is well to explain that this machine does not develop negatives—that is, films or plates as they are taken from the camera after exposure. Its purpose is solely to make prints from these negatives after they have been developed in the customary way, but a tremendous saving in time over the usual methods of printing is said to be accomplished.



How the negative is inserted in the printing machine. Twelve 100-watt lamps make the exposure on the roll of print paper

Says Dr. Paul Kammerer:
The Leopard *Can* Change His Spots

And Fathers Can Pass Their Good Characteristics to Their Sons

By Lane Stuart

THAT acquired characteristics—the deft fingers of the musician, painter, or skilled artisan; the ingenuity of the inventor, the wisdom of the statesman—can be passed on from father to son is the amazing message recently brought to America by Dr. Paul Kammerer, biologist, of the University of Vienna.

An Enthusiast

I called on him the day after he arrived in this country. I found him confined to his bed in a New York hotel, the victim of a recurring fever contracted on one of his early exploring trips in Africa; but even his sickness could not diminish his enthusiasm once he was on the subject of his life work—the endeavor to prove scientifically that the highest qualities we have built into our lives can be passed on to future generations.

Doctor Kammerer has reached his revolutionary conclusions after almost 20 years of scientific experiment with lower animals.

He has grown eyes in blind newts. He has given to land toads the physical characteristics and habits of the water-dwelling branch of the species. He has changed the color of the spots on a salamander's back. Eventually, he says, he hopes to prove that the leopard's spots can be changed in the same way.

Changes Permanent

He has caused certain amphibians to alter their breeding habits. And these new characteristics, produced by patient scientific work on successive generations, he asserts, are made permanent, and are transmitted by their possessors to their progeny, on and on.

"These," he explained to me, "certainly are acquired characteristics, not natural ones. Take the proteus, or blind newt. This animal for centuries has inhabited the dark caverns of the seas. It has had no need for eyes, and its eyes have become mere rudimentary organs under its skin. I exposed successive generations of newts to red light—constantly, night and day—and at last a newt appeared whose eyes had pushed through its skin. Moreover, this characteristic was transmitted to the next generation.

"If this transmission of acquired characteristics can be effected with some animals, I am convinced that it will apply to man as well. Principles applying to one branch of life invariably apply to all others—plant life and animal life alike. The discoveries of medical science are the result of scientific work on the lower animals—guinea pigs, rats, and rabbits. Science derives its principles regarding life from the lower animals, then works gradually to man.

Proof from Animals

"It is on this method of scientific research that I base my conclusions. I cannot prove absolutely that the characteristics acquired by one generation of man will be transmitted to the next. Possibly I never shall be able to do so. Man's span of life is too long for one investigator to observe facts regarding several generations. With the lower animals we can do so because they are short-lived—five or six generations live and die in a decade. My hope, though, is to prove this principle of the transmission of acquired characteristics in the lower animals so conclusively that science must accept it as being true of man to the same degree.

"Long after I was convinced by my experiments that it was true, I was gratified by a striking corroboration in the findings of Dr. Richard Semon, a German scientist. Doctor Semon discovered that a child before birth bore callouses on its feet, near the big toe and, the heel, where its ancestors had developed them through many generations of walking.

Seeking More Evidence

Callous growths on the feet certainly are an acquired characteristic. This is the only instance I have heard of where the principles I am seeking to prove seem to apply to the human race. One case, of course, is not conclusive. But others will come to light; of that I feel certain.

"It is not in the transmission of purely physical characteristics, however, that the human race is chiefly concerned. I hold also that mental, ethical, and moral characteristics, once acquired, can be made inherent. I believe that every deed, every happening not only leaves an indelible imprint on the individual but is transmitted to the

A Second Darwin?

DR. PAUL KAMMERER, biologist of the University of Vienna, has been a storm center of scientific discussion ever since he first announced his revolutionary doctrine of "short cut evolution"—the theory that a son directly inherits the acquired characteristics of his father.

Scientists of world-wide reputation have hailed him as the greatest biologist of his time, the logical successor to Darwin; others of equal standing have been skeptical, and a few have called him a misguided enthusiast.

The attention of the world was focused on Doctor Kammerer when, about a year ago, 50 professors and students at Cambridge University invited him to England to demonstrate his theories.

And now he comes to America to lecture to our leading universities. The accompanying interview is presented in the belief that whether you agree with Doctor Kammerer or not, you will be interested in his theories.

offspring. Hence, I believe, too, that favorable characteristics produced in one generation through normal life and wholesome environment can improve the human race and result in marvelous progress from generation to generation.

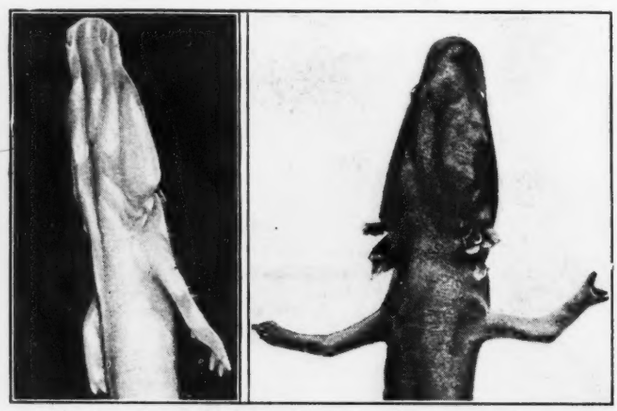
"This is more than eugenics. I may call it eugenics from a positive standpoint, rather than from a negative one. That is to say, instead of seeking to improve the human race by the elimination of bad qualities in succeeding generations, I hold that the improvement should be brought about by inducing positive, good qualities which will be transmitted to the offspring. This, of course, is a matter for the future. I can only hope to point the way.

"Science long has recognized that certain animals acquire a color similar to the color of their surroundings. For example, the hair of certain rats in the deserts is sand-colored. Every one knows of the white-furred animals that inhabit the polar regions. I seek to prove that the acquisition of these colors is due to the animals' direct imitation of their surroundings. Further, I hope to prove that their bodies are altered in form and structure, and that these changes are not characteristic of the lower animals alone, but of mammals as well, and probably man.

Salamander confined on black soil, showing growth at one year intervals and pronounced tendency toward blacker color

Salamander confined on yellow soil, showing changes at one-year intervals and increasingly lighter color

Both of the salamanders, the growth of which is pictured above, were descendants of a fire salamander confined on yellow soil during its life



These two photographs show the results of the remarkable experiment in which Doctor Kammerer claims to have grown eyes on a blind newt to prove the inheritance of acquired characteristics. At the left is the eyeless newt that inhabits dark sea depths. At the right is a newt that has grown eyes after successive generations subjected constantly to red light. The eyes have pushed through its head

Color Changes Inherited

"In experiments with salamanders I have shown that specimens forced to live on a yellow background eventually become almost yellow and that their progeny is yellow at birth. Likewise, salamanders that have lived on a black background become almost entirely black, and the next generation is black as well. By placing land toads on an island in a warm aquarium through which cool water was flowing, I caused them to plunge into the water to escape the heat and to acquire, in time, the characteristics of the water-dwelling toads, including pads on the feet. These characteristics have become permanent and have been transmitted to the next generation.

"Strange to say, I have noted that the acquired characteristics become stronger and of greater hereditary power than the original, or natural characteristics. Probably I can make the reason for this clear by a simple analogy. A man is more conscious of new shoes on his feet or a new ring on his finger than of old shoes or an old ring he has been wearing for years. That is because the new articles irritate.

New Qualities Gain Force

A somewhat similar sort of irritation is caused in animals by a new physical characteristic, because it is unfamiliar. And the acquired characteristic, because it is constantly making its presence evident, exerts a stronger force in propagation than the old characteristics.

"Dr. Francis B. Sumner, of California, by placing rats in cold and warm rooms, has caused the animals to vary in the heaviness and texture of their coats. He also has performed experiments that have indicated that color changes in animals are due in large measure to the animals' adaptation to their surroundings. That is to say, color changes are due not merely to the survival of those animals that in colorings are best fitted to live in their particular surroundings, but to more or less rapid acquisition by the animals of the color of their surroundings.

"These changes—in color, form, structure and traits—biologists generally hold come about through evolutionary changes through many generations. My contention is that the evolution is shorter; that the changed characteristics are acquired by one generation and transmitted to the next, after which they are permanent and will remain so until change of environment causes other changes.

"It is a long step from my experiments to the formulation of principles that may be applied to man. I am convinced, though, that some day we shall have well-defined laws regarding the transmission of characteristics in the human race. We shall know how favorable characteristics may be acquired and how they may be passed on. Then the world always will be assured of leaders in the arts and sciences."

Doctor Kammerer at work in his laboratory, examining a rat with which he is experimenting to prove his theories

Doctor Kammerer is a slight man of 43, an ascetic in appearance. He is a musician and composer and the author of a dozen books and innumerable scientific papers; yet his revolutionary theories have met with slight encouragement from the scientists of his native land.

When he sought the right to lecture at the University of Vienna 12 years ago, the scientific paper that accompanied his application was rejected summarily, and the application denied. A little later, though, this same paper was awarded the Soemmering prize, his country's most coveted award for distinguished scientific work.

Called to English University

Then the University of Vienna sought out Doctor Kammerer, making place for him as lecturer. Yet he had to live, support his laboratory and buy biological specimens, on about $150 a year. Then he was called to the colors.

After the war, he no longer was able to maintain a laboratory, and the pursuit of his work seemed hopeless until, about a year ago, he was invited to lecture before a group of scientists at Cambridge University, England. There the attention of the world was drawn to him, and his present visit to America is the result.

Fish Planters to Make Our Rivers Yield Fortunes in Pearls

Here is the channel catfish of the Mississippi, one of our fresh-water fishes upon which young pearl-producing mussels feed and thrive

A microscopic photograph of embryo mussels, future producers of priceless pearls, which Uncle Sam's scientists are propagating for commercial use

By Robert E. Martin

SCIENCE soon will place millions of dollars in the inland streams of the United States, there to be gathered by any one who desires.

This amazing announcement was made recently by the United States Bureau of Fisheries which, through scientific propagation of fresh-water mussels, plans to make dozens of rivers throughout the land yield rich harvests of wealth in pearls.

During the last year the streams of the country are estimated to have given up $15,000,000 in these gems, produced by natural means within the shells of mussels that lie along the bottoms of rivers like the Mississippi, and the Black River and White River in Arkansas—streams that have been dragged by pearl fishers for years.

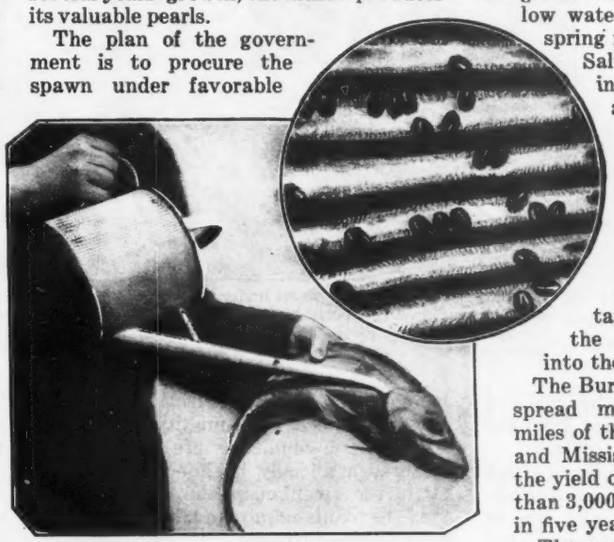
Science Enriches the Pearl Market

But this enormous annual wealth in fresh-water pearls is small, say government experimenters, compared with what may be expected from scientific methods of increasing pearl production—methods that will be adopted this year as the result of long experiments by the Bureau of Fisheries with 500 varieties of mussels found in the Mississippi Valley. In from four to six years they expect a crop of pearls that will surpass in treasure the richest "strikes" made in the gold-fields of California and Alaska.

The experiments of the bureau were conducted at its station at Fairview, Ia. Of the 500 varieties of mussels tested, 40 were shown to lend themselves to pearl culture. Many of these, it was found, could be stimulated to the production of larger and finer pearls. The fact that single pearls worth $25,000 already have been produced naturally and taken from the streams of the country, gives some indication of what may be expected with scientific propagation.

The spawn of the mussel is a parasite. It attaches itself to the gills and fins of certain fish, particularly catfish and bass. Unless it can find this lodgment and feed upon the tissues of the fish, it will die. In from nine to 24 days, depending on the species, the mussel is developed sufficiently to drop away from the fish and sink to the bed of the river. There, after several years' growth, the mussel produces its valuable pearls.

The plan of the government is to procure the spawn under favorable conditions and to see that the spawn has its opportunity to thrive by attaching itself to fish. This will be done by inoculating fish that are left stranded in shallow water when rivers recede after spring floods.



Inoculating a fish with embryo mussels. Water containing the embryos is poured into the gills. The inset shows how the young mussels attach themselves to the gills, feeding upon the tissues

Salvaging these fishes by placing them back in the rivers is a work carried on extensively by the Bureau of Fisheries, millions of fish being rescued by government men every year. The method of inoculating the stranded fish with mussel spawn will be either to place them in water containing the spawn or to pour the spawn-filled water directly into the gills.

The Bureau of Fisheries already has spread mussel spawn through 350 miles of the Mississippi between Iowa and Mississippi. It is estimated that the yield of this sowing will be not less than 3,000,000 mussels, many of which in five years or so will contain pearls.

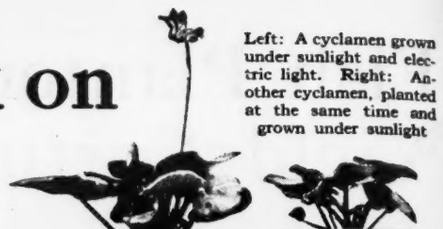
The mussels are gathered by dragging the bed of the river with blunt hooks. Then they are subjected to heat sufficient to cause the shell to open without ruining the pearls. After the mussels have been inspected for pearls, buttons and other ornaments are made from the shells, or they are ground up to serve as chicken feed and fertilizer.

The largest pearls found in United States rivers include one weighing 103 grains, taken from the Black River, Ark., in 1904, and one weighing 68 grains, from the Wisconsin shore of the Mississippi in 1907. These sold respectively for $25,000 and $15,000. The record catch for a month contained pearls worth $300,000, taken by Wisconsin fishermen.

Government fishermen rescuing fishes that have been stranded in land-locked sloughs along the Mississippi after the spring floods. Before they are returned to the river, these fishes will be inoculated with embryo mussels so that they may yield a great pearl harvest

Putting Plants to Work on the Night Shift

Science Speeds Up Nature's Food Factories



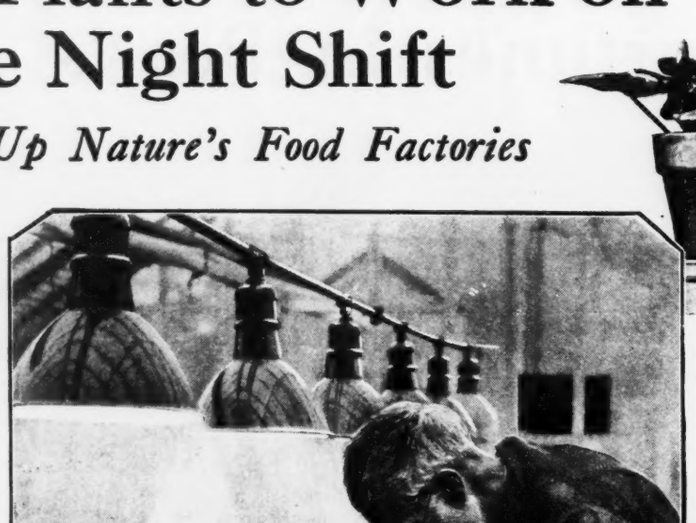
Left: A cyclamen grown under sunlight and electric light. Right: Another cyclamen, planted at the same time and grown under sunlight

By Newton Burke

YEARS ago, through the development of artificial light, science made possible the 24-hour day in industry. Now, through the same agency, science is putting plants, like human workmen, on the night shift. For scientific research has revealed the fact that certain plants may be grown by electric light. Subjected to artificial light after nightfall, these plants are found to be hurried to maturity with double their normal speed and to acquire as well a vigor equal to, and possibly greater than that of plants grown under natural conditions.

Growth Is Doubled

In a six weeks' experiment conducted recently by the Westinghouse Electric and Manufacturing Co., in a greenhouse at Baldwin, N. Y., 12 varieties of flowers and 12 of vegetables were sown. Half of the plants, in addition to being exposed to the sun during the day, were bathed in the light of six 500-watt electric lamps for five hours each night. The other half received only the light and heat of the sun, being shielded from the rays of the lamps by oilcloth curtains.



Speeding up the growth of plants under the rays of powerful electric lights during recent tests conducted by the Westinghouse Electric and Manufacturing Co., in a greenhouse at Baldwin, Long Island. Julius Heinrichs, veteran florist, who superintended the tests, is shown above measuring the plants

At the end of six weeks, Professor Hugh Findlay, of the Department of Agriculture, Columbia University, who was in charge of the demonstration, found that some of the plants that had been kept working night and day were about twice as far advanced in growth as those that had received only the sunlight. These were plants that bear broad leaves—a characteristic enabling them to absorb the extra light in larger proportion than plants with smaller leaves.

The experiment has been hailed as a useful, practical discovery that can be applied immediately in commercial greenhouses to make growers more independent of weather vagaries as affecting the light and heat of the sun.

Even more astounding are the experiments in scientific plant culture recently undertaken in a plant laboratory established at Yonkers, N. Y. There 30 scientific workers actually are manufacturing every climatic condition that might affect plant growth. There, too, plants are being put on the night shift, but they are being supplied as well with tropical temperatures and with humidity as desired. Atmospheric conditions are being manufactured artificially by injecting into the air of the greenhouses the carbon dioxid that the plants require in larger quantities than nature provides.

The ultimate purpose of the Yonkers laboratory, known as the Thompson Institute for Plant Research, is to conserve and improve the food supply of the world for future generations. The institution has been established by funds provided by Colonel William Boyce Thompson, of Yonkers, noted mining engineer, financier, and philanthropist. Several years ago Colonel Thompson recognized an alarming possibility that the hand of famine might some day be laid on America, the land of plenty. He foresaw that within 25 years at the rate our population is growing, the farmlands of the United States, under present methods of cultivation, will be taxed to their limit of production; in other words, that the yield of the farms will be barely equal to feed the 140,000,000 or 150,000,000 people who will then be in the country.

By inclosing healthy aster plants in these glass cages, then introducing a different species of insect into each cage, experimenters at the Thompson Institute for Plant Research discovered that the plant disease known as "asters' yellows" is carried by the brown leaf-hopper, a very tiny insect

Patriotic Research

He determined to do his share to increase the native crops of America so that this country need never be dependent on the rest of the world for food. The result was the establishment of the Thompson Institute, which bears the same relation to the world of plants that the Rockefeller Institute for Medical Research bears to mankind.

Control of the diseases of plants and improvement in methods of cultivation, comparable with the sanitary measures by which modern science has bettered the living conditions of man and added to his span of life, have been awaiting the efforts of just such a pathfinder. The Thompson Institute will stand midway between the State and Federal agriculture experiment stations, busied with solutions of immediate practical problems, and the universities and colleges where botany departments are devoted to pure science. Its research work will be conducted always with the practical end in view of eventually bettering and increasing the food supply of the world.

The institute occupies a nine-acre plot, and comprises a quadrangle of laboratory buildings and extensive greenhouses. One laboratory building has been completed at a cost of $700,000 and now houses 30 scientific workers. These include not only plant experts, but chemists, microscopists, bacteriologists, and specialists in other

related branches of scientific research.

The laboratory equipment includes the world's most improved apparatus for plant research. Individual laboratories are provided for the experimenters, each laboratory having electric current of 110 and 220 volts, vacuum pipes, high and low steam pressure, gas, refrigeration, and compressed air as standard equipment. There are darkrooms for photographic work, refrigerating chambers, and a microchemistry laboratory.

In one of the greenhouses "sunlight" can be maintained at night, as in the Columbia University experiment at Baldwin, by swinging a crane that supports a bank of 42 1000-watt electric lamps above the plants. But electricity, although making possible a night shift for plants, supplies only a poor imitation of sunlight; for, while the sun gives 37 per cent light and 63 per cent heat, electric light gives only 7 per cent light and 93 per cent heat. The tremendous heat generated by the lights in this greenhouse would be sufficient to bake the plants under cultivation as well as to make it impossible for any one to enter. So the heat of the lamps is "filtered" by causing their rays to pass through two glass plates between which is flowing constantly a stream of clear, cool water.

How the addition of a "night shift" with artificial light increases plant growth. The cucumber plant lettered *6-A* and the lettuce plant, *7-A*, were grown under both artificial light and sunlight, while the cucumber, *6-B*, and the lettuce, *7-B*, were grown under sunlight only. The upper picture shows Dr. William Crocker, director of the Thompson Institute for Plant Research and one of the foremost botanists in America

Still other greenhouses are provided with roofs of "spectrum glass"—especially colored glass that absorbs the ultra-violet and other rays of the sun detrimental to the growth of plants. Under these roofs plants have been found to develop with double their natural speed.

An investigation during the last six months to determine the carrying agent of "asters' yellows," a virus disease that attacks asters, indicates the sort of practical work the institute will carry on. Believing that this disease was transmitted by insects, Dr. L. O. Kunkel, plant pathologist at the institute, constructed about 25 glass cages—greenhouses in miniature—in each of which was placed several healthy aster plants. Insects then were introduced into the cages, a different species in each. Soon it was observed that only in the cage containing specimens of the brown leaf hopper, a tiny insect not much larger than a mosquito, did the plants develop yellows. This determined the carrier of the disease. The next step will be to find the causative agent, which may or may not be a protozoan—a single cell of animal life that has its first stage of being in the insect carrier. That found, the next problem will be to produce a plant capable of resisting the disease.

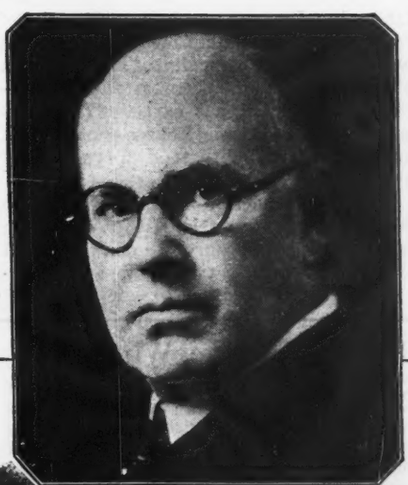
It is interesting to note that the method used to determine the carrier of asters' yellows was almost identically the method employed in discovering that yellow fever was transmitted by the mosquito. In fact, there is a remarkable similarity between the diseases of plants and human diseases.

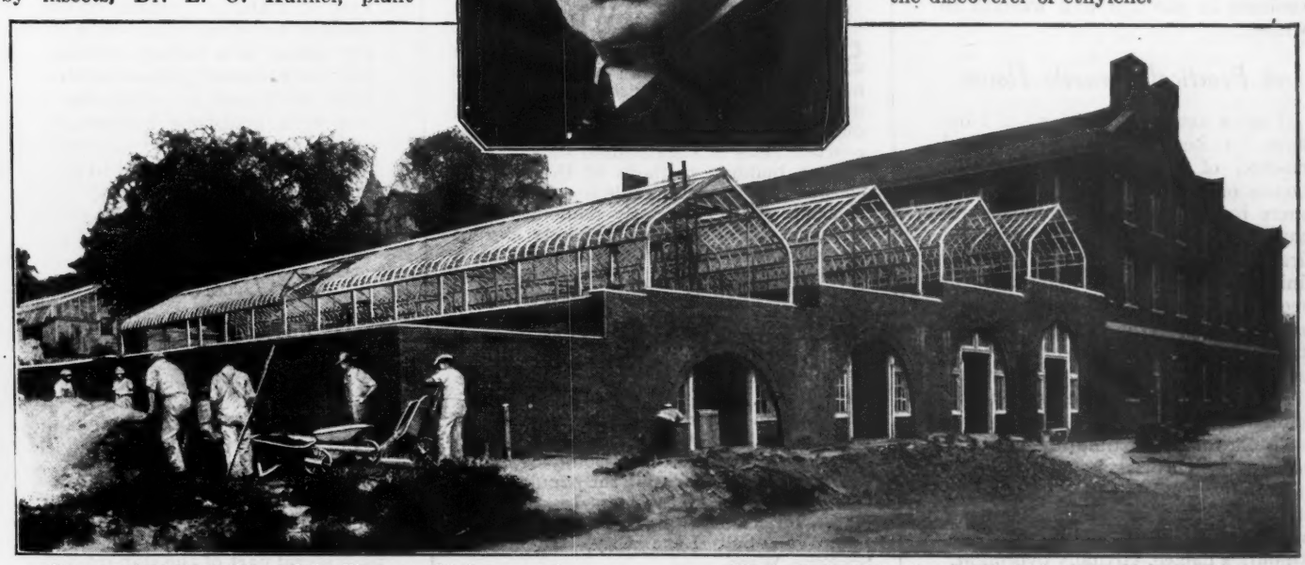
Plant research offers unlimited fascinating possibilities for food conservation.

The loss through plant diseases of a single bushel of wheat from an acre may not seem appalling at first glance; yet if a single bushel is lost from every one of the millions of acres that are under cultivation, a tremendous blow is struck the world's food supply.

Conversely, adding one bushel of wheat to the yield of an acre may not appear to be an accomplishment of enormous importance, yet the wheat crop of Canada has been increased 20,000,000 bushels a year by this means.

It is toward this end that the energies of the scientists at the Thompson Institute are being employed. The director of the institute is William Crocker, one of America's foremost botanists, famous as the discoverer of ethylene.





The new $700,000 building of the Thompson Institute, nearing completion at Yonkers, N. Y. Here 30 scientific workers will use the world's most improved laboratory equipment to study plant diseases and their cure. The inset shows the founder of the institute, Colonel William Boyce Thompson, noted mining engineer, financier, and philanthropist, who is doing a patriotic work in endeavoring to increase America's food yield

My Plan for Cheaper Homes

World-Famous Inventor Offers Novel Method of Building Distinctive "Custom-Made" Dwellings of Concrete Slabs

Architect's drawing of a distinctive dwelling such as Simon Lake says can be built of concrete slabs by his new process. Stone walls, slate-shingled roofs, and other exterior decorations can be produced, he says, by placing a veneer of the desired material on the slabs as they are cast

By Simon Lake

NEARLY everybody has felt the pressure of the housing shortage that has existed in the United States for several years. At a time when this shortage was most acute, there occurred to me the possibility of developing a new type of dwelling—one that admitted of speedy construction and less costly materials, yet one that could be erected by a small number of men.

Casting one of the reinforced concrete slabs for a Lake-constructed house. One slab is said to be equivalent to 2000 bricks. Casting requires only a few minutes, and the slab may be used in construction on the following day after it is cast

From Ships to Houses

It may be remembered that during the war concrete was proposed as a substitute for lumber or steel in the construction of ships and that a number of ships were built of this material. I took out some patents for concrete ships having double walls to make them suitable for carrying grain, and it was only natural to apply this construction to houses. I built my first experimental house in 1918 and also built a number of test slabs.

Out of that experiment has come a new plan for house building based on the use of reinforced concrete slabs made in standard sizes for all parts of the house. These slabs are hollow, so that a layer of air acts as an insulator between the inner and outer surfaces; insuring coolness in summer and warmth in winter.

A Practical Concrete House

I have now completed what I believe to be an entirely practical method of manufacturing concrete houses of any type, from a small seashore bungalow to a skyscraper, according to any plans that may be drawn, with any sort of exterior finish or decorations that may be specified, with any sort of interior arrangement of rooms; houses that are rainproof, moisture-proof, cold-proof and heatproof, earthquake-proof, and all but indestructible. Moreover, I believe these houses can be built for approximately half the cost for which brick houses could be erected by the usual standard method of construction. Small houses of the bungalow type can be put up like Aladdin's palace, virtually overnight.

This may sound like a flight of fancy, but I assure you it is not. Plans of construction and manufacture have been worked out scientifically. The strength of construction has been tested by municipal experts and has exceeded their requirements. Model houses have been built and have withstood a variety of drastic tests.

In this connection it may be well to mention here that a scientist investigating earthquake and fireproof construction of houses on behalf of the Japanese government recently studied my new method of house-building, indorsed it enthusiastically, and is taking the details of my process back to Tokio with him.

The essential difference between the new plan of construction I have evolved and my former experiments in the building of "one-piece" houses consists in the fact that, while the early houses were ready made, those that I plan to build now may be custom made. That is to say, the prospective home owner need not be limited in choice to a fixed number of "ready made" plans, but may have his house built according to his architect's plans, no matter what the style of architecture or of exterior finish.

The house may be constructed on the lines of a Dutch Colonial cottage, a modern American mansion, a square city house, or a factory building. It may have stucco walls and a tile roof, brick walls and a polychrome slate roof or a fieldstone basement with upper floors shingled. It may be painted, it may be treated to give the effect of marble, or it may remain undisguised and unadorned concrete construction.

For Decorative Effects

The distinctive decorative effects are produced by placing a "veneer" of the desired material on the surface of the slab when casting. The effect of a heavy roof of slate, for example, is obtained by installing on the slabs slate shingles only a sixteenth of an inch thick. The effects of tile, brickwork, or stone are produced similarly. Once installed, the "veneer" becomes an integral part of the slab itself.

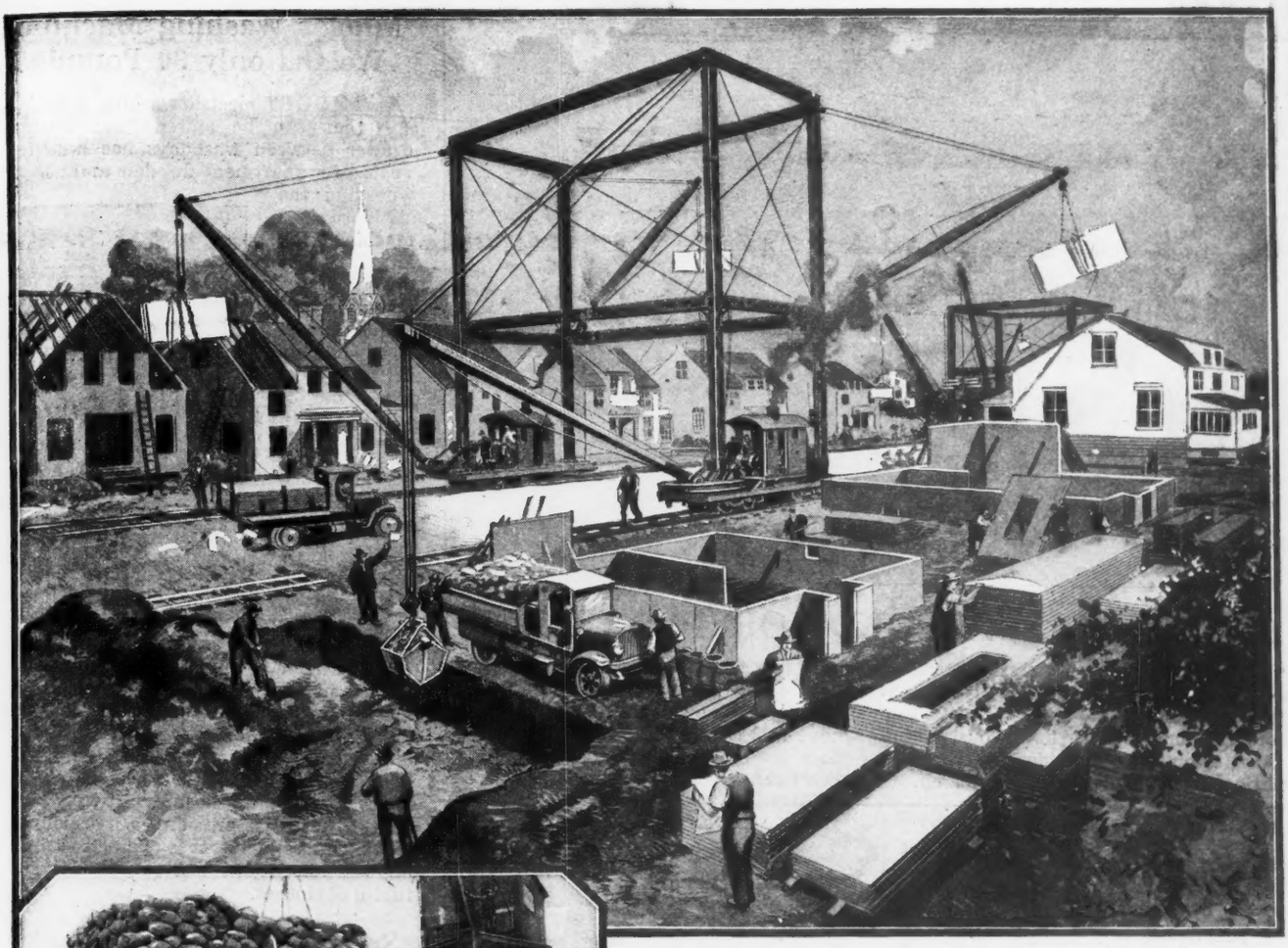
In my plans for building custom

Homes by the Wholesale

SIMON LAKE, world-famous inventor of submarine boats, here describes a novel method he has devised of constructing distinctive houses of a wide variety of dimensions and architecture from precast concrete slabs of standardized sizes.

That building methods of the sort are considered quite practicable is shown by the amazing project recently announced by Henry Ford of erecting a whole city of 30,000 cement and wooden houses on a 5000-acre tract near the Ford plant at Dearborn. The homes Mr. Ford purposes building are to be constructed according to a plan perfected some time ago by Thomas A. Edison, which permits 12 different types of cement houses to be molded in the same set of forms.

How tremendous a job is the simultaneous construction of 30,000 homes is apparent when we realize that they would be about capable of accommodating the population of such cities as Des Moines, Ia., Albany, N. Y., Paterson, N. J., Reading, Pa., Norfolk, Va., Salt Lake City, Utah, and Spokane, Wash.



This drawing shows how the inventor foresees the application of his method of constructing "custom-made" slab houses to large-scale suburban development. The slabs would be transported to the development site by railway, lighter, or motor truck and carried to each house site by a traveling derrick running on tracks. In building a house the derrick also would lift the slabs into place. All excavation would be done by mechanical shovels, as shown. At the left: Testing carrying strength of the walls of a small house constructed by the Lake process. The weight on the roof is 31,000 pounds, equivalent to 765 pounds a linear foot

made houses I am making use of the well known manufacturing principle of standardized parts. The units of construction are slabs 12, 16, 20, or 24 feet in length and up to 10 feet in width. Those lengths are used because I have found them convenient and best adapted to the various types of houses. The 10-foot width was adopted because that is the maximum width of slab that may be transported safely on a flat car.

The slabs are to be cast in a central plant, carried to the location of the proposed buildings, and lifted into place by derricks. One wall slab, of the 10-by-20-foot size, which can be cast in a few minutes, is equivalent to 2000 bricks. Since the "setting" of the concrete can be speeded by a special process I have developed of circulating warm air through its hollow interior, the slabs can be installed on the second day following their casting.

That this method of construction should be cheaper in labor cost to the unit of area than the building processes commonly employed is apparent. A further saving in this particular is effected by the use of derricks to lift the units in place. Since by using the slabs we start with a saving of at least 50 per cent on materials, I feel confident that the efficient application of my process can result in a 50 per cent cut in the cost of a house.

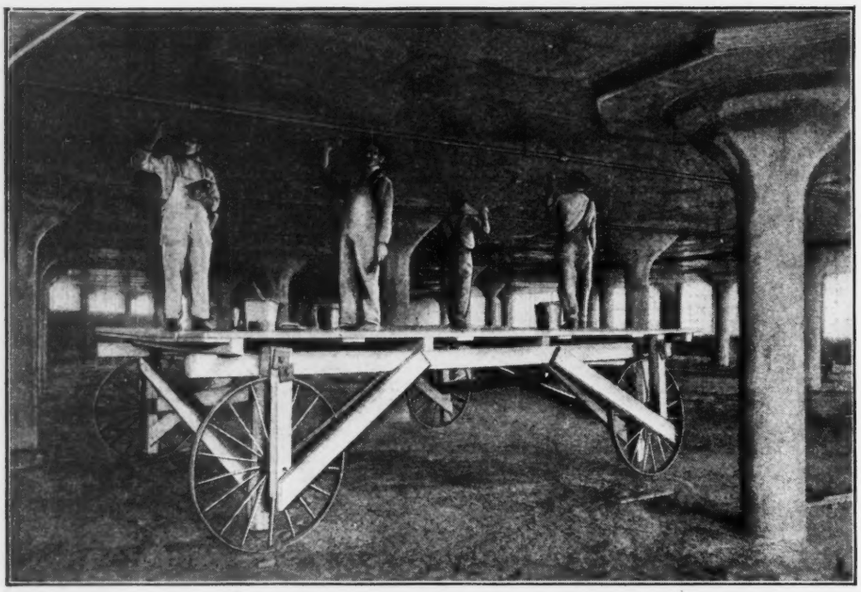
Except for purely decorative features inside or out, the houses I have planned would be of slab units throughout from foundation to roof. Wooden or other flooring, if desired for decorative effect, would be laid over the concrete floor slabs. The units would be joined by a patented method, which would make the completed structure virtually one piece, effectually sealing it against moisture and air leakage. These units also might be utilized on a steel skeleton in the construction of sky-scrapers.

Several test houses constructed entirely on these plans have withstood shocks and jars when being transported from place to place by motor truck, greater by far than the strain put on any structure in Japan in the recent earthquake.

I have estimated that for $3500 it will be possible to build a seven-roomed home of the type that has recently come into great popularity in suburban developments. This is much less than a good quality frame house of the same sort would cost almost anywhere in the United States.

And not only will the new process enable the home-builder to obtain a house at half the cost of other type dwellings, but also it will save him practically all cost of upkeep and repairs, assuring him of a home that should stand for many generations.

Demonstrating that the Lake-built house is earthquake-proof. The truck carrying the house has slipped into a deep rut, subjecting the building to a strain that the inventor says is greater than that exerted on any structure in the Japanese quake. The house was unharmed



A MOVING SCAFFOLD FOR PLASTERERS

THE sight of four plasterers suspending their work for an expensive period while they moved their staging, gave to a foreman for the Aberthaw Construction Co., Boston, Mass., an idea for the elimination of this waste in transportation.

On two sets of light wheels, taken from concrete buggies, he mounted a working platform, as shown above. The plasterers move this rolling platform from place to place by pushing against the wall with their hands.

Combination Bed and Easy Chair

COMBINING the functions of easy chair and bed, a newly invented folding armchair with an ingenious arrangement of fittings and compartments under the seat is designed especially for use in the small modern apartment, or for invalids.

By pressing a lever, the occupant can adjust his position to any desired angle. A bookrack, writing-table, and medicine chest keep all the more necessary comforts within easy reach. The two front legs of the chair slide forward.

How the folding chair is converted into lounging chair and bed. Pressure on a lever adjusts the back to any desired angle. Note the handy compartment beneath

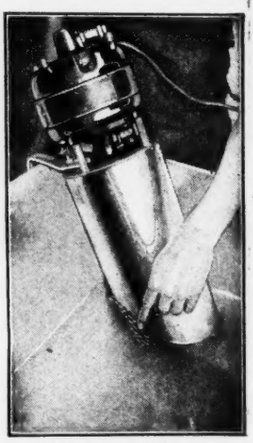
SNOW MACHINE LOADS AS IT SHOVELS

The tractor conveyor loading snow into a truck as it is shoveled

MOUNTED on a track-laying tractor, this powerful snow conveyor and loader, perfected at Aurora, Ill., is designed to remove snow quickly from city streets. The manufacturers claim it will load a five-ton truck with eight cubic yards of snow in 2½ minutes. While a powerful shovel plunges into the drifts, the endless belt conveyor carries the snow upward to the truck.

Midget Washing Machine Weighs only 30 Pounds

A MIDGET electric washing machine that can be stored in a bureau drawer between washdays has been invented for apartment dwellers and others who find the standard sized machine too large. It is cylindrical, six inches in diameter and 22 inches long. With the electric motor, which fits in the top, it is said to weigh only 30 pounds.

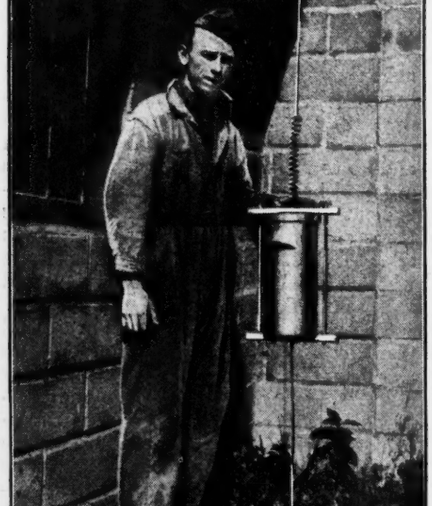


Finger points to holes through which water circulates

The machine is placed in a corner of a tub, wash boiler, bathtub or sink filled with hot water and the soiled clothing. A four-bladed centrifugal pump in the lower part of the cylinder, into which water flows through small holes, ejects a vigorous current that swirls the clothes, cleaning them. This current has a jet pressure of five pounds to the square inch. It is claimed that 10 minutes' operation suffices to clean a tubful of clothes.

Spring Churns the Butter with Little Urging

SUSPENDED from a 12-inch spring, this ingenious self-operating churn is said to turn out a batch of butter in five minutes. The cylindrical container, held between two wooden strips by long thumbscrews, is hooked to the spring which, in turn, is attached to a rope tied to a convenient beam. Once set in motion, the churn needs little urging.



The churn and its ingenious spring suspension

Socket Holder Converts Vase into Lamp

ORNAMENTAL vases may be converted instantly into attractive electric lamps by the insertion of this newly invented socket attachment. Within wide limits, the fixture will fit any size vase.

Should the receptacle be desired for flowers, the attachment may be withdrawn. Trophy cups can become distinctive utilities.

Two spring clips press the inner walls of the vase so firmly that the vase-lamp

Inserting the socket attachment in vase

may be picked up by the top. No boring and no weighting with sand are necessary. The cylinder shown between the two clips is a two-pound weight that brings the center of gravity beneath the mouth of the vase, stabilizing the lamp.

Safety Stand for Smokers Won't Spill Ashes

HERE'S a smoker's stand that can't fall over or spill ashes, and that extinguishes lighted matches and stubs dropped into it. The weighted base causes the stand to return to an upright position when tipped. Anything dropped in the ash receiver falls into the hollow base, where lack of oxygen extinguishes tobacco embers and burning matches. It is claimed also that the base retains all stale tobacco fumes.

The huge swimming pool nearing completion

World's Largest Swimming Pool 1000 Feet Long

AN $80,000 swimming pool, said to be the largest in the world, has been completed in a 60-acre park at San Francisco in the hope that it will serve as an attraction to bring the Olympic games to America.

Measurements of the great tank are standardized for official aquatic contests. It is 1000 feet long and 100 feet wide, with the exception of a central portion 50 yards wide to provide for a racing course across the pool. At one end is a diving pit 14 feet deep. The rest of the pool ranges in depth from three to nine feet.

A 16-inch steel pipe line will bring 5000 gallons of water a minute from the Pacific Ocean, thus keeping in constant circulation the 6,300,000 gallons in the pool, which will be emptied by gravity.

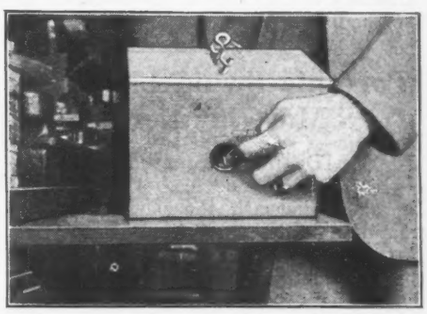
Calking seams in the concrete floor

The concrete floor is formed in sections, with one-inch seams between each section, permitting the concrete to expand without cracking. To prevent the salt water from leaking through them, the seams are calked with oakum and poured with plastic asphaltic cement.

This Strong Box Sounds Burglar Alarm

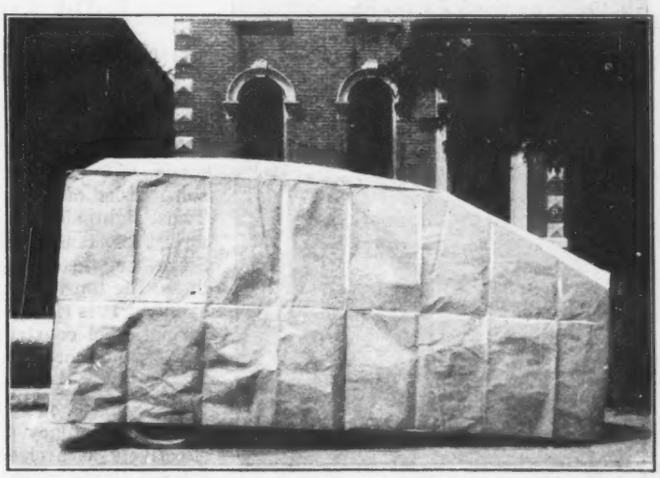
THE burglar who lifts this steel strong box will be surprised. Immediately a loud electric bell will start clanging and the racket won't stop even if the box is replaced in its original position.

A lever inside is thrown to set the alarm. A metal pin, capable of oscillation, projects from the bottom of the box, as shown in the illustration. When the alarm is set and the box is resting on a table or in a drawer, this pin presses against the supporting surface. The slightest disturbance of the box causes the pin to close an electric circuit that actuates the bell alarm, which rings until the spring is unwound.

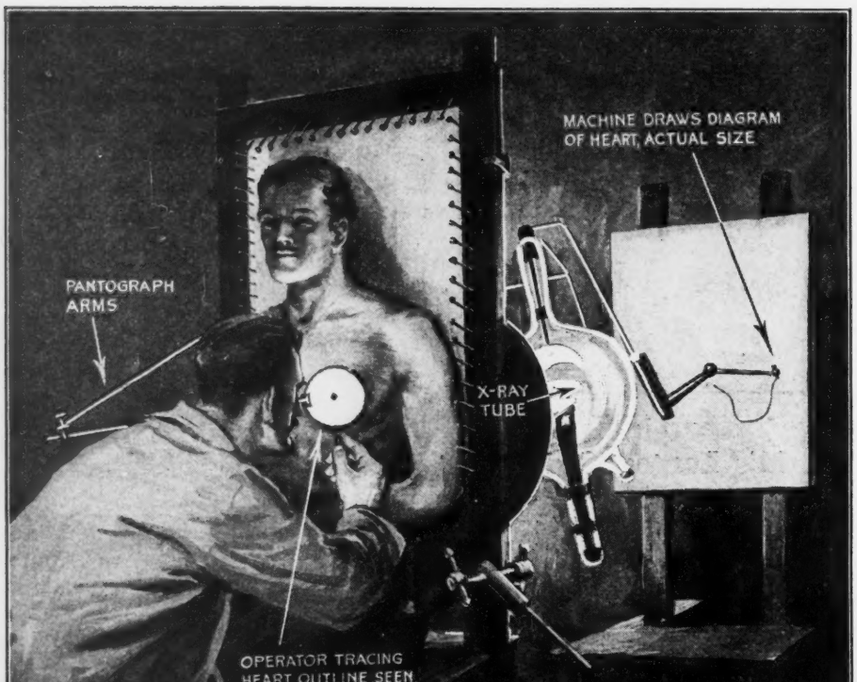


PAPER COVER PROTECTS AUTOMOBILE

TO PROTECT motor cars stored for the winter, shielding them from the fine dirt and dust that injure the finish, this easily adjusted cover of strong, heavy paper has been introduced by a manufacturing concern in Shelbyville, Ind. The covers are made in various sizes to fit standard cars, and are designed to serve both the individual owner or the dealer.



This paper auto cover can be folded into a small, compact bundle


MACHINE DRAWS DIAGRAM OF HEART, ACTUAL SIZE
PANTOGRAPH ARMS
X-RAY TUBE
OPERATOR TRACING HEART OUTLINE SEEN THROUGH DISK

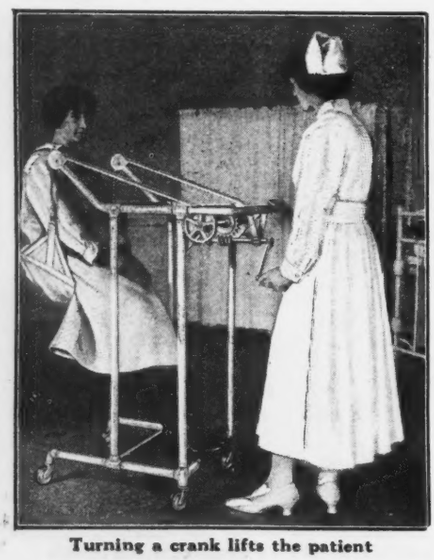
HUMAN HEART MEASURED BY X-RAYS

PRECISE measurement of the human heart is said to have been made possible by this X-ray pantograph apparatus in use at the British National Hospital for Diseases of the Heart. It is called the "orthodiagraph."

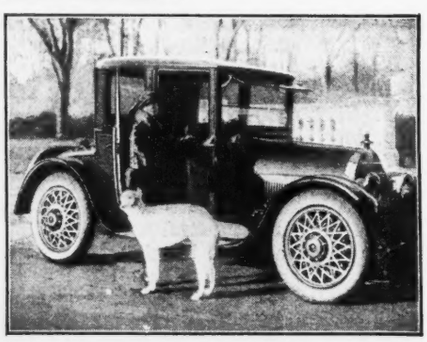
As the X-rays reveal to the operator the outline of the heart through an observation disk, he traces the outline with an indicator. To the indicator is attached the arm of a pantograph, which draws a diagram of the heart, actual size.

Portable Swing Lifts and Moves Patients

INVALIDS may be moved in comfort by this simple device. A canvas seat is placed beneath the patient, who is raised in a sitting position on the bed. Attached to the ends of the seat are two sprocket chains running through supporting arms to sprockets turned by a hand crank. By turning the crank, the attendant lifts the patient from the bed. The apparatus moves on casters.



Turning a crank lifts the patient



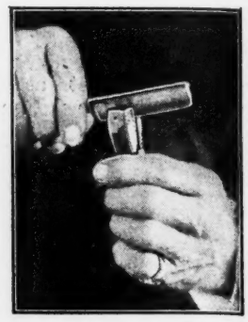
Tension Wheels Cut from Solid Steel Disks

A NEW type of tension wheel for automobiles, smart in appearance and said to possess advantages over the common wire wheel, is popular in Europe.

The wheel of lattice construction is made of two members stamped from solid disks of an especially light steel. Thus, tightening of individual nipples to adjust the tension of spokes is obviated. Since the wheel is made of two stamped disks, the tension naturally is distributed evenly. It is claimed that because of the special steel construction, it is stronger, lighter, and more resilient than other types.

WATER-GLASS, mixed with boiling water to the consistency of syrup, can be used effectively as a cleanser for clothes, discolored dishes, marble, or enamel ware.

This Handy Tool Sharpens Razors or Knives



A SIMPLE implement for sharpening razors and knives, devised by Rockwell A. Loomis, of Guatemala, consists of a tubular handle with a threaded socket in which are inserted the shanks of jaw members. Each jaw holds a sharpening stone.

The blade of the knife or razor is inserted in a V-shaped opening between the jaws and drawn across the stones. The abrasive stones are detachably mounted so that coarse or fine stones may be used.

Useful Garage Truck

THIS handy truck, built low so heavy objects need little lifting, and fitted with rugged ball-bearing wheels, is designed to save time and muscle in the auto-repair shop.

Moving an auto engine

Grocer Candles a Dozen Eggs at a Time

"CANDLING," the process by which light is made to reveal the devastation wrought by an egg's age, recently was made conveniently available to his housewife patrons by an enterprising grocer.

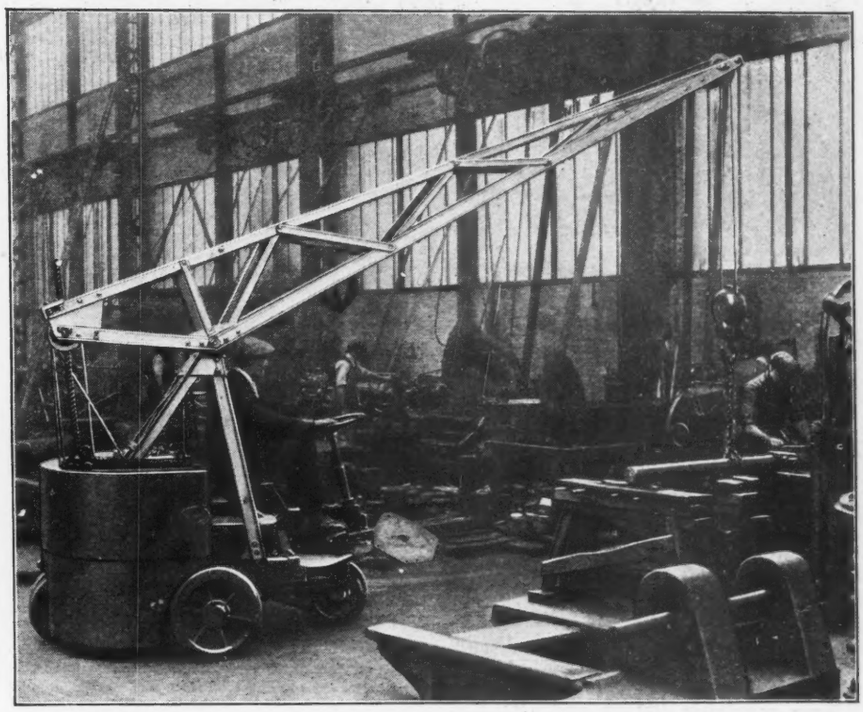
His device, an observation chamber built of old boxes and containing an electric light, bares all egg secrets.

Testing a dozen eggs at once

RUNABOUT ELECTRIC CRANE SPEEDS UP FACTORY WORK

BASED on an entirely new principle, an unusual type of "runabout" electric crane recently has been introduced into British factories and engineering works. It derricks, hoists, and travels under its own power, and it can penetrate into any corner of a manufacturing plant inaccessible to a fixed crane installation.

The machine might be compared with a giant hand, ever ready to do heavy work, such as lifting a heavy casting on to a lathe, or taking steel forgings from a furnace to the machine.



This traveling crane can penetrate into factory corners inaccessible to a fixed crane

Crane Carries Own Power Unit

Cranes usually used for such purposes have long wheel bases, and consequently are clumsy and difficult to handle. These difficulties have been overcome in the new crane by combining lifting gear and chassis in a compact unit. The crane is supported by four pairs of wheels. The front and back wheels serve for steering, while two pairs of side wheels are for turning the crane. These side wheels do not swivel. They are driven by electric motors suspended from the chassis, acting through a reduction gear.

When turning, the motors are connected in such a manner that they turn in opposite directions; so that the crane turns on the spot about its own axis.

For turning, the front and rear wheels are placed at right angles to the side wheels.

The hoisting and derricking operations are accomplished by a single motor driving rope barrels through spur-and-worm gearing. A new brake mechanism is fitted to the clutches through which the lifting gear is driven. When the clutch is being withdrawn, the brake is applied gradually from the start, and vice versa when clutching in. This is said to save a great deal of current. In addition, the motor is automatically stopped or started when the clutch lever is operated.

Current is supplied by a storage battery that also acts as a balance weight.

HOW MUCH SCIENCE DO YOU KNOW?

EACH of the 12 important scientific facts embodied in the answers to the questions asked below may come in handy for you some day.

You may be the only one in a group to know one or more of them, when the questions are raised. A sure and ready answer will bring you the respect always accorded the man who knows, the man who understands the principles that underlie and animate the world about him.

Or you may have occasion to put some of them to highly practical use. Understanding the principle of the fireless cooker, for example, might enable you to improvise one on a camping trip.

These "Monthly Dozens" that appear in each issue of POPULAR SCIENCE MONTHLY are an easy and fascinating course in science, a course with the zest of a game. Test your knowledge of science with these questions. When you've done your best, turn to page 150 for the correct answers.

You'll be surprised at the amount of real satisfaction and practical value you will gain from this knowledge of the simple facts of science.

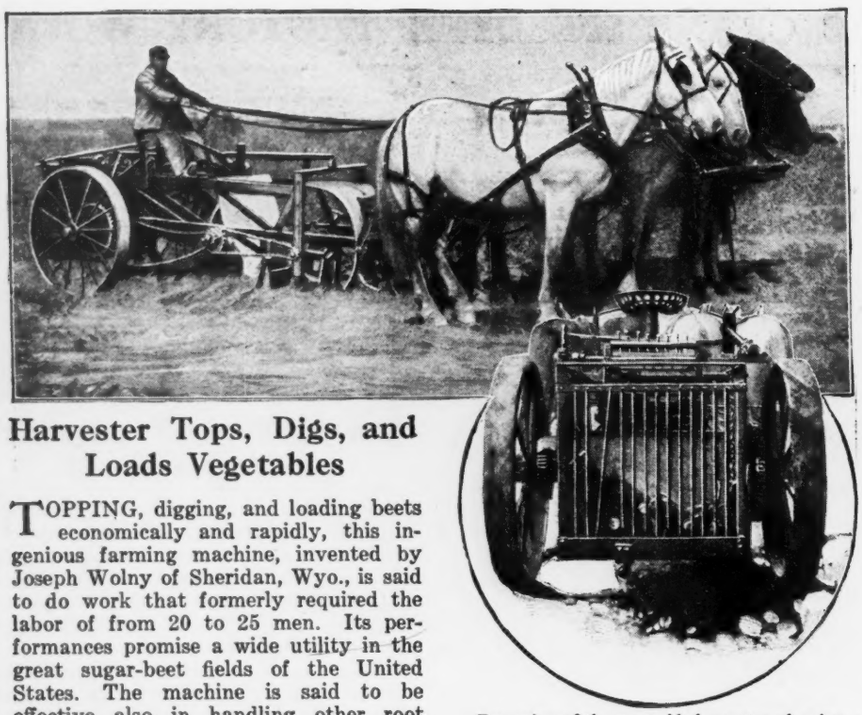
1. *What is the difference between coal and diamonds?*
2. *Why does the bleeding from a cut soon stop?*
3. *Why does food continue to cook after being placed in a fireless cooker?*
4. *Can the songs of birds be written down as we write other music?*
5. *Why is it cooler on a mountain top, though the sun is closer?*
6. *Is it true that a drowning person always comes up three times?*
7. *What is the safest stimulant?*
8. *What is the speed of thought?*
9. *Why is the water of the sea salty?*
10. *How can you make air hot without applying heat to it?*
11. *How does the phonograph reproduce sound?*
12. *How do fireflies produce their light?*

Smoker's Reading Lamp Has Ashtray Attached

FOR the man who likes to smoke while he reads, this combination ash receiver, cigar rest, and match receptacle is attached to the base of a portable reading lamp that will clamp on a table edge, a chair arm, or almost any convenient rest.

The device also is adapted for card playing, for the lamp when clamped requires only a few inches of table surface and the ashtray is below the table level.

Lamp and ashtray attached to table

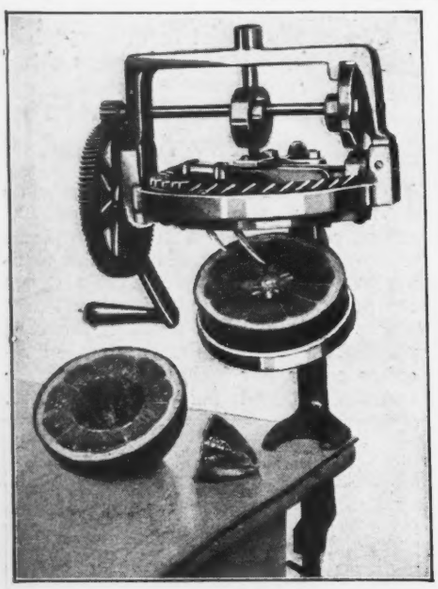


Harvester Tops, Digs, and Loads Vegetables

TOPPING, digging, and loading beets economically and rapidly, this ingenious farming machine, invented by Joseph Wolny of Sheridan, Wyo., is said to do work that formerly required the labor of from 20 to 25 men. Its performances promise a wide utility in the great sugar-beet fields of the United States. The machine is said to be effective also in handling other root vegetables, such as carrots and turnips.

Four revolving knives and one stationary knife, the latter fastened into two flowing guides, constitute the topping mechanism that is adjustable to any height. A plowlike arrangement digs the beets and a conveyor carries them to a box at the rear. When this box is full, the operator pushes a lever and the contents are dumped in a pile.

Rear view of the vegetable harvester, showing how beets are dumped from loaded container



Mechanical Servant Cuts and Cores Oranges

CUTTING and coring oranges or grapefruit quickly and attractively, this light, handy new machine is designed especially for the housewife who takes pride in equipping her kitchen with time- and labor-saving mechanical servants. It is claimed to work with five times the speed of hands.

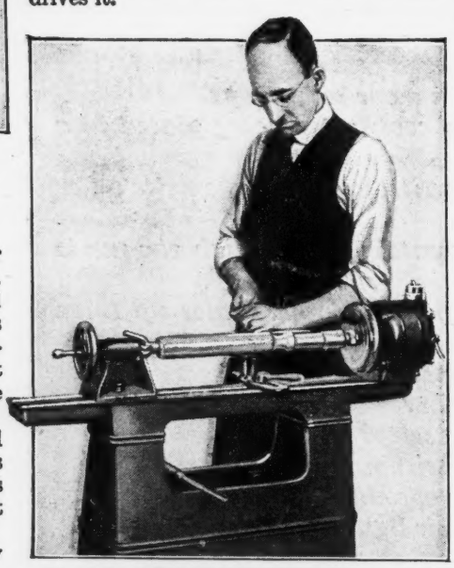
A pair of curved blades is arranged ingeniously to give an up and down as well as a circular motion. The fruit is held just beneath the blades in a cup that forces it upward.

The machine may be clamped easily to the edge of a table.

Smallest Motor-Driven Woodworking Lathe

A NEW single-speed bench lathe, said to be the smallest woodworking lathe with motor-driven headstock, is being manufactured for the smaller turning operations that make up the bulk of the work in nearly all woodworking shops.

The lathe is intended for work up to six inches in diameter and operates at 3400 revolutions a minute. It weighs but 203 pounds and can be moved with fair ease. It is 46 inches high and 40 inches long. The sub-base is open, serving as a holder for tools. An entirely inclosed one-third-horsepower motor drives it.



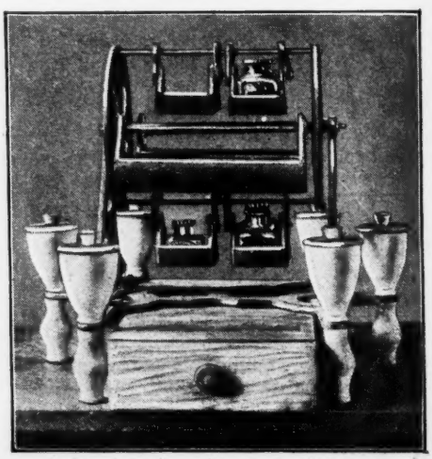
The midget lathe, showing headstock motor

This Handy Tool Combines Wrench and Pliers

COMBINING a pair of pliers with a monkey wrench that can be adjusted instantly without turning the usual knurled wheel, this unique tool has been designed especially for home use.

When used as a wrench, the jaws are adjusted to the object they are to clamp and the toothed tip of the pliers handle is engaged in one of the depressions of the corrugated strip beneath the lower jaw. This holds the jaws firmly in place.

Desk "Ferris Wheel" Holds Pencils, Pens, and Ink



SERVING as a compact and handy container for office materials, the Ferris wheel device shown above has been designed to save time and annoyance for the business man.

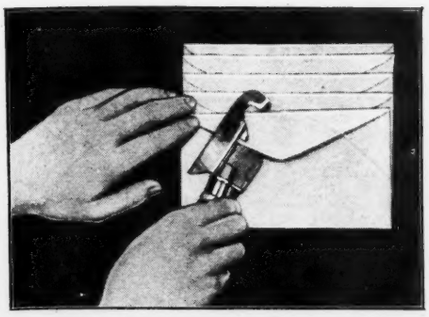
Extending between the two wheels are four bars, each suspending two ink bottles in two holders. Two troughs, one on each of two other bars, hold pens and pencils. These, like the Ferris wheel cars, cannot tip.

At the base of the device are six covered cups that serve as containers for pen points, pins, paper clips, and similar small articles.

A drawer seven inches wide, two inches deep, and 15 inches long receives papers. The wheel is so balanced that it will remain stationary in whatever position it is placed.

"Tin Hats" Worn by Miners

ARMY "tin hats," designed to turn shrapnel in battles of the World War, are now being used as head protection against rock and ore in mines of California, West Virginia, and Oklahoma.



A Rapid Envelope Sealer for Office Use

THIS small but efficient envelope sealer is designed for use in offices where a more expensive device is not advisable. It is but a trifle larger than a fountain pen.

The handle contains enough water for sealing 1000 envelopes. Attached to the handle is a pan containing a felt pad that moistens the glue on the envelope flap as the sealer is drawn along it. A presser foot, immediately behind the pad pan, presses down and seals the flap.

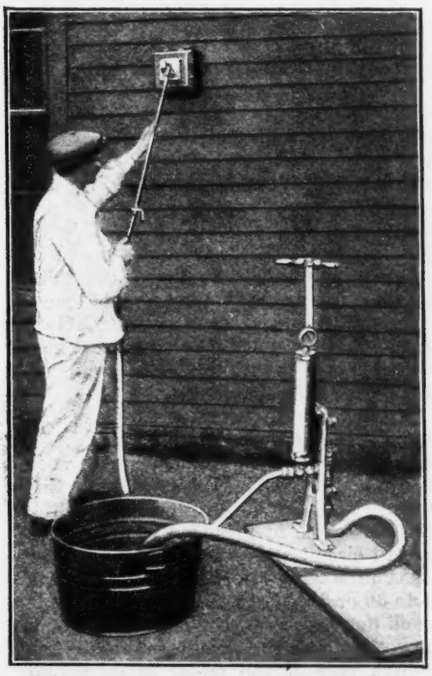
It is claimed that 60 envelopes a minute can be sealed with the device.

Guard Attachment Aids in Spraying Paint

PROTECTION of machinery, stock, windows, and other surroundings while adjacent surfaces are being sprayed with calcimine, whitewash or similar paints, is said to be possible through the use of a newly perfected guard attachment for the paint sprayer.

This guard, it is claimed, makes the spraying machine a superior tool for painting walls and flat surfaces, or for oiling large floor spaces.

The swing joint and nozzle work independently of the guard, and the nozzle may be focused at any angle. This permits of spraying trees and shrubbery.



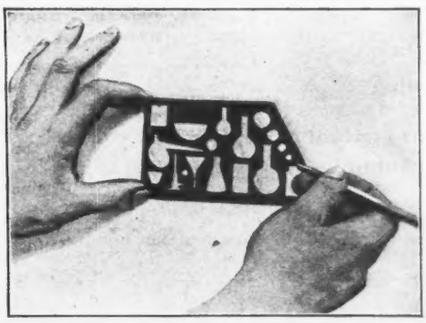
The paint spray with guard attachment

MOVE TOWN TO BUILD A RESERVOIR

THE entire town of American Falls, on the Snake River, Idaho, is to be moved by United States government engineers in the course of building what is to be the largest reservoir in the country; for the projected storage basin will cover deeply the present site of the town. Eighty-three thousand acres surrounding the town are to be inundated when the project is completed.

Above: View of the Snake River, near American Falls, Idaho, which will supply water for the huge reservoir. At the left: Part of the town of American Falls which will be moved to make way for the government project. When the reservoir is completed, 83,000 acres will be inundated

This gigantic reservoir will have a capacity of 1,500,000 acre-feet of water, and will involve an expenditure at present estimated at more than $12,000,000.



Chemical Drawings Made Easy by Templet

TO AID scientists, students, and draftsmen to produce neater and more accurate drawings in which chemical apparatus appears, this novel celluloid templet or drawing guide has been devised. The figures are punched through.

Using this templet, one inexperienced man can make a hundred diagrams while an artist working freehand is completing one or two.

Typewriter Records Voice

IMPROVING on the dictation phonograph commonly used in business offices, Martin Bandli, a Swiss inventor, claims to have perfected a machine that will typewrite direct from the spoken word, thus doing away with the necessity of first dictating to a phonograph and then passing the record on to a typist for transcription.

A speed of from 90 to 100 words a minute—about as fast as the average man can dictate—is claimed for the new machine, which is operated electrically.

Mechanical Page Turner for Armless Readers

THE difficulties experienced by armless persons in turning the leaves of books or magazines and in holding down the pages have been overcome to a large extent by a simple mechanical finger with a rubber tip.

Holding one end of the device between his teeth, the armless reader manipulates it so that the tip gains purchase at one corner of the page. When used to hold the page, the instrument rests on the tip and the two legs.

Turning a page with rubber-tipped finger

How to Kill Your Radio Troubles

And Silence the Howling Demons of Noise

By Jack Binns
America's Foremost Writer on Radio

CLICKETY-CLACK, Rat-tat-tat-tat, bing, bang, E-e-e-e-yow-e-e, crack! This is not a sample of the new type of jazz orchestra, but merely a weak imitation of what a radio receiver can do when it rears up on its hind legs and "tells the world."

There are two types of troubles that can be experienced with a receiver that is not working properly. The first is the presence of a whole orchestra of noise demons. The second is the total absence of sounds or noises of any kind.

With the possible exception of the demon static, there is no reason why a properly made receiver should not function properly without noise or trouble, giving clear, distortionless signals from stations within its receiving range.

The Commonest Troubles

What, then, are the exact causes of the varieties of trouble that bring grief to almost every radio fan at some stage of the game? First, let's see if we can't put our fingers on the most common of the trouble-makers, determine their locations, and expose the secrets of their noise-making. Afterward, we'll discuss the means of guarding against them in designing and constructing our receivers.

All trouble usually can be traced to defective parts, poor construction, or unskilful operation.

If you get crackling noises, the first thing to do is to determine whether they are caused by static or by the set. This can be done easily by listening in with aerial and ground disconnected. If that eliminates or cuts down the crackling noises, the trouble is due to static. If the noise persists with aerial and ground disconnected, you may absolve the static imp from all blame.

Many of the irregular crackling noises in a receiver are due to run-down batteries, poor wiring connections, and defective rheostats and condensers.

A steady, regular, staccato beat note, somewhat like the steady patter of a machine-gun, often can be traced to an improper value of the grid leak. The remedy is to try grid leaks of different values till the right one is obtained.

A steady humming noise usually is caused by near-by power lines or lighting circuits near the aerial or lead-in wire. The remedy is to erect your aerial as far as possible from such lines and as nearly as possible at right angles to them.

A loose connection or open circuit in the grid circuit of the detector stage often will cause a sharp drumming noise that can be eliminated by checking up the grid circuit connections.

Whistling or howling noises may be due to too much regeneration, too many turns in the tickler-coil winding, poorly designed transformers, location of transformers too close to each other, improper routing of wires so that grid and plate wires run closely parallel to each other, body capacity effects when the hand is brought near the controls, neglect to use a fixed condenser across the primary winding of the first stage transformer, and overloading of tubes.

The remedy for most of these troubles is obvious. Capacity effects practically can be eliminated by making sure that the rotary plates of tuning condensers are connected with the grounded or battery sides of the circuits in which they are used. Another source of capacity effects is the method used by some makers of variocouplers or variometers to lead out the connections from the rotor windings.

A lead from the rotor winding never should be soldered or otherwise fastened to the shaft of the rotor. Flexible wires should be connected with the ends of the windings and the free ends connected with the outside binding posts or connections. Where a hollow tube is used as the shaft, these flexible wires can be run from the inside of the rotor, through the hole in the tube, and out through the end of the tube to the binding posts or outside connections.

A whistling noise changing in pitch without any adjustment of the receiver is caused by a neighbor tuning in his single-circuit regenerative set, with the circuit in an oscillating condition. The only remedy is to find out who operates the troublesome set and convince him that he should use a double-circuit set or tune in his present set with the tube filament turned down as low as possible.

Fig. 5. To assure good contact springs of the tube socket and tube prongs, bend up the springs as shown above

Every Noise Has a Meaning

THIS chart will help you locate your radio troubles, if you use the noises you hear as a guide. Tack it up for handy reference.

NOISE	*TROUBLE*
Crackling	Static, run-down batteries, poor wiring connections, or defective rheostats and condensers.
Whistling, howling	Too much regeneration, too many turns in tickler coil winding, poorly designed transformers, transformers too close together, parallel wiring, body capacity, overloading of tubes.
Sharp Drumming	Loose connection or open circuit in the grid circuit of the detector stage.
Machine-gun beat	Incorrect value of the grid leak.
Steady humming	Usually caused by near-by power lines or lighting circuits near the aerial or lead-in wire.
No noise at all	Poor aerial or ground.

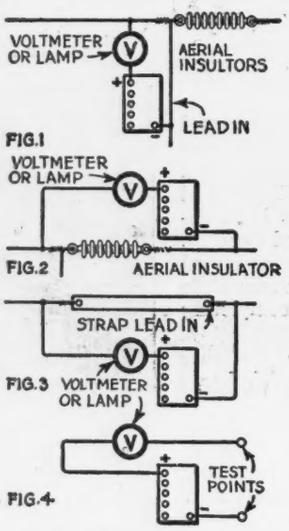


Fig. 1. How to test for open circuit between aerial and lead-in
Fig. 2. Test for short circuit between aerial and aerial support wires
Fig. 3. Test for open circuit in strap lead-in
Fig. 4. Voltmeter and battery test circuit, with testing points

When You Hear No Sounds

Don't let noises discourage you. The fan who gets noises at least gets something, even though it is unwelcome. He is better off than the fan who expectantly turns on the juice, plugs in the phones, and hears—nothing.

One of the most common causes of "no noise at all" is a poor aerial or ground. Be sure before you make any changes in your set that the trouble is not due to this cause. You can do so by making the tests illustrated in Figs. 1, 2, and 3, using the test circuit shown in Fig. 4.

A voltmeter with graduations reading up to 30 or 35 volts will be found suitable for all purposes in testing. In connecting the voltmeter in the circuit, make sure the positive pole of the meter is connected

The Radio Imps'll Get You if You Don't Watch Out

HERE are the noise imps of radio—the whole orchestra of howling, squealing, whistling, crackling, pounding demons that play havoc with radio reception, spoil the fun, and ruin your temper unless you can track them to their lair and silence them.

Greatest bugaboo of them all is static, the unconquered, who grinds his crackler in your ears while he laughs in your face.

The home of the whistlers, squealers, and howlers is to be found in tuning elements and transformers of poor design, in faulty wiring or unskilful operation.

Other cracklers usually are found hiding in run-down batteries, poor wiring connections, defective rheostats and condensers, or in dust between condenser plates.

The machine-gunners of the crew have their headquarters in the incorrect grid leak, while the anvil chorus of the blacksmiths comes from dust in the condensers and from weak batteries.

with the positive pole of the battery by touching the free end of the meter with the negative terminal of the battery. If you get a reading, the meter is connected properly. If you do not, reverse the connections to the meter so that you get a reading when the free end of the meter is connected with the negative of the battery.

Testing for Ground Connection

To insure a good ground connection, you can make a temporary connection to another ground and then insert your test circuit between your regular ground and the temporary ground. If you get a reading, the ground connection is all right. Another way is to test around the ground clamp and see that the ground wire is making a good contact through the clamp with the ground.

Many fans, especially beginners, often forget to connect aerial and ground when testing.

A common source of trouble is poor contact of tube prongs with socket springs. Before connecting the sockets with the set, the springs should be bent up as shown in Fig. 5. A wise precaution is to bend up these springs every so often and clean off the ends of the tube prongs with a fine file, so that they will make a good contact with the springs.

Another source of trouble in tube sockets is loose binding-post connections with contact springs. Screws and binding posts always should be tightened before the socket is connected with the circuit.

So much for those who are experiencing difficulty with receivers already constructed.

Forestall Trouble Later On

In radio an ounce of prevention is worth more than a pound of cure. Testing the parts before connecting them may take time, but it will save you more time, temper, and embarrassment later on. A few simple tests often will prevent any possibility of trouble after the set is built and ready to operate.

First of all, test your batteries. This can be done easily in the manner illustrated in Fig. 4, by touching the two test points together. If a 22½-volt B battery gives a reading of less than 15 volts, throw it away and get a new one.

Coils can be tested by connecting one end of the coil with one test point of the test circuit, as shown in Fig. 4, and the other end of the coil with the other test point of the circuit. The voltmeter should show a steady reading. Where the coils of transformers are being tested, a lower reading will be obtained because of the resistance of the coil. The important thing, however, is a steady reading.

All coils of variocouplers, variometers, and transformers should be tested in the manner described above and as shown in Fig. 6. Each coil of every transformer should be tested separately. The primary-coil terminals usually are marked *P* and *B*, and the secondary-coil terminals are marked *G* and *F*.

Another test, to determine whether there is any connection between the two coils, is to touch one test point to one terminal of the primary coil and the other test point to one terminal of the secondary coil. To make sure that the windings are not connected with the core of the transformer, one test point should

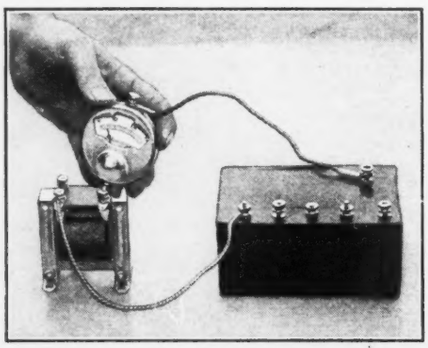


Fig. 6. How to test the transformer for open circuits, by using the voltmeter and battery

be touched to the core or case of the transformer and the other test point touched first on one terminal of the primary, then on a terminal of the secondary. No readings should be obtained during this test.

The binding posts and screws of rheostats and other parts should be tightened

Fig. 7. Before connecting the rheostat with the circuit, tighten all connections as shown

up carefully before being used in the circuit. Neglect of this precaution often is the cause of troubles impossible to locate later on.

Condensers should be tested as shown in Fig. 8, one test point being connected with one terminal of the condenser and the other test point with the other condenser terminal. While the test circuit is connected, the rotary plates should be revolved. During this operation, the needle should not falter. If it does, it indicates that at some point the rotary plates are touching stationary plates or that dust is short-circuiting the plates. If the short circuit is caused by dust, the spaces between the plates should be cleaned by blowing through them; if by touching plates, the rotary plates should be straightened carefully.

Rubbing contacts, either in variocoupler, variometers, or variable condensers, should not be relied upon. The best method is to connect the leads, terminals, or parts with soldered flexible connections.

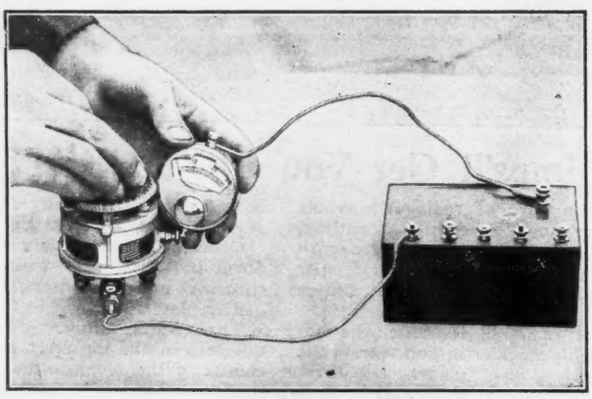


Fig. 8. This illustration shows the method of testing the condenser for short circuits, using voltmeter and battery

Provide Stops for Rotors

Stops should be provided to prevent rotors of variocouplers and variometers and rotary plates of condensers from being turned through more than one revolution. If this is not done, the leads will be twisted or broken, or the insulation worn off, causing short circuits.

Fixed condensers, especially the grid condenser, should be tested to make sure that there are no short-circuited condensers. When the condensers are connected between the test points, the voltmeter should show no reading.

Jacks contribute a large portion of the troubles in amplifier stages. In double-circuit jacks, poor contact of the inner springs with the outer springs often are the cause of no signals or, at best, weak signals in the amplifier stages. Make sure before you connect the jacks that they are free from this fault.

Testing Circuits for Opens

After you have connected the set, test the various circuits for opens before connecting the batteries. In the plate circuit, for instance, touch one test point to the plate terminal of the socket, and the other test point to the positive B battery connection, to make sure that there is a complete circuit between those points. The same should be done with other parts of the circuit.

Before you jump to the conclusion that something is wrong with your set, try various values of B and C battery voltage, since the correct values are important if distortion is to be eliminated.

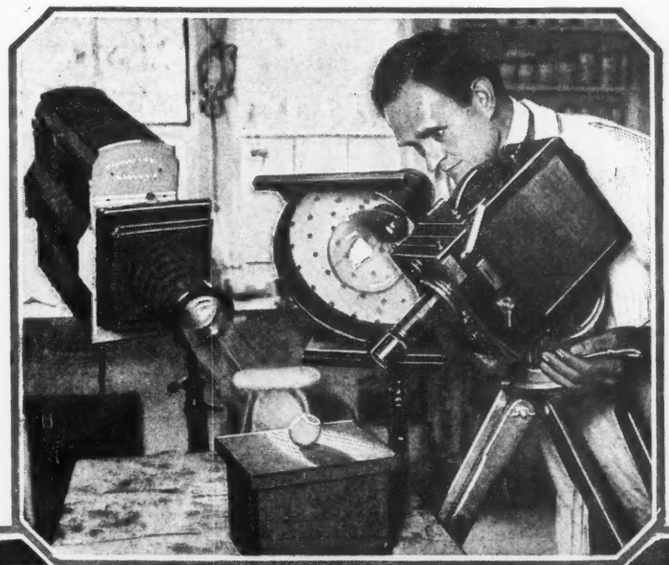
If you don't get results after making tests and checking up your wiring, you will find it an actual saving in time and temper to take the whole works apart and make the tests on the apparatus as I have described them.

Don't try to make all the tests, wire up the receiver, and get good results all in one evening. It simply can't be done.

***NEXT** month Jack Binns will tell of the most recent progress in the development of secret radio and of the possibilities of private wireless communication. Don't miss this timely article on the discoveries of the day.*

Evolution of an Egg in the Movies

By Charles F. Herm
Formerly of the American Museum of Natural History, Inventor of the Motion-Picture Camera to Photograph Embryo Life

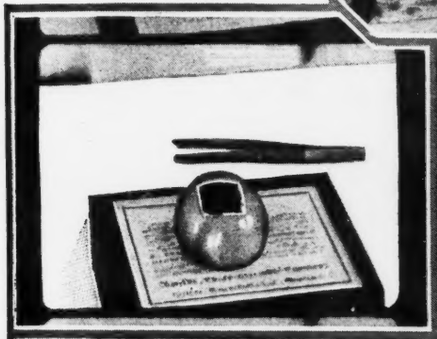


THE untiring eye of science is the motion-picture camera. The human eye has its limit of endurance. That means, of course, that a scientist observing a delicate but slow process beneath the microscope cannot see the full sequence of the process.

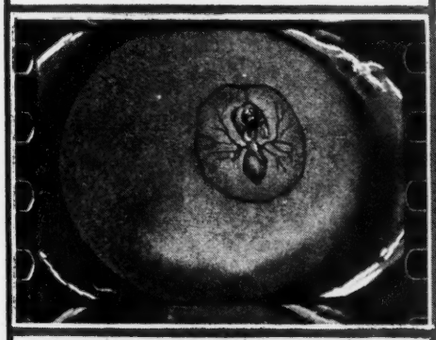
But the motion-picture camera does not tire. It sees, and records, the most minute details. We have already traced, without a single break in the sequence, the first stir of life within a fertile egg. We have traced the life history of germs in segregated living tissue!

My movie photographs of the growth of the embryo within the egg, some of which are reproduced here, were obtained by focusing the "time-condensing" camera into the egg, through a small window cut in the shell.

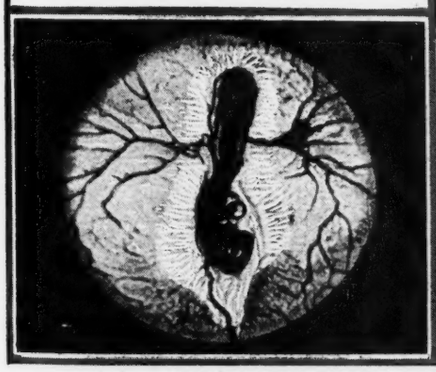
It has required six years of my time to adapt the motion-picture camera to scientific uses. But now I know that the life history of disease germs will be solved; and I dare to hope that the camera may solve science's greatest enigma—the development of embryo life.



1. Fertilized egg prepared for photographing, with sealed window in the top of the shell for observation of the growth within

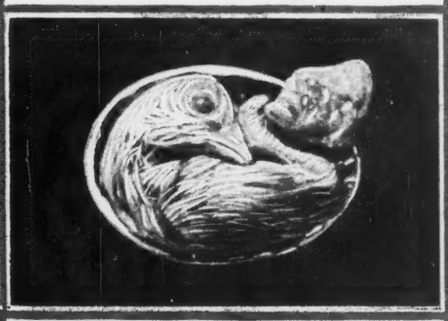


2. Interior view of the same egg, showing the growing chick embryo only 24 hours old

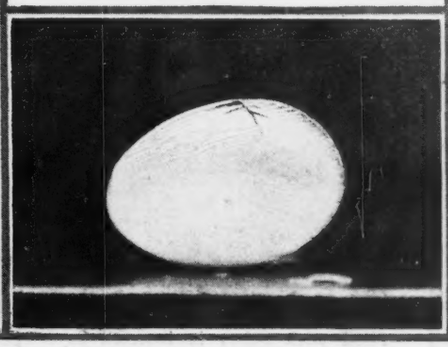


3. The embryo at the age of 56 hours. The camera is driven by a time clock that automatically photographs a motion picture of the embryo's progress every few seconds

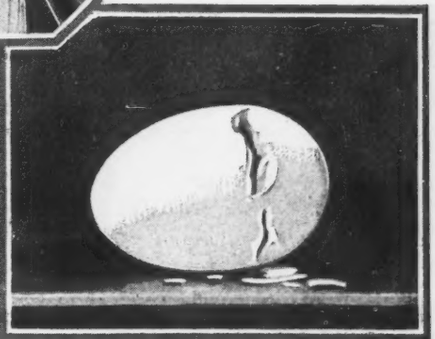
4. The embryo at the end of 10 days. The top picture shows Doctor Herm making these remarkable embryo photographs with his newly invented movie camera



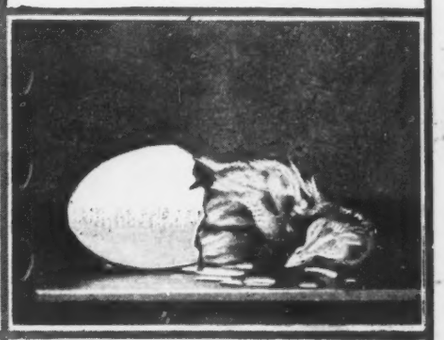
5. At the end of 20 days. Here the embryo is shown almost fully developed, imprisoned in the shell from which it must free itself



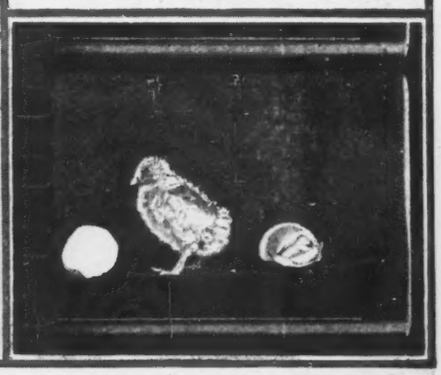
6. Beginning to hatch. The small crack at the top of the shell shows where the chick is just beginning to pick its way through



7. The camera now gives a complete picture story of the hatching, showing how the chick breaks the shell a little at a time



8. Hatched. Still weak and wet, the newborn chick has chopped its own way out



9. The baby chicken! From the first stir of life in the shell, the camera has recorded a continuous story of the processes of incubation to preserve for scientific study

New Mechanical Servants Invented

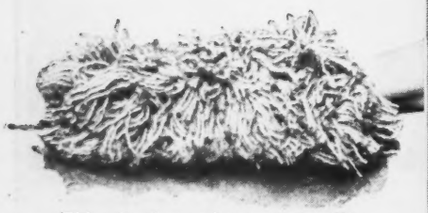
A twist of this little cutter is said to remove the shell cleanly from the top of an egg by means of toothed spring jaws

In the battle to protect clothing from moths that destroy more than $100,000,000 worth of goods yearly, this household all-metal clothing vault has been devised. It is airtight. Within it garments are fumigated by chemicals that are said to kill the larvae as well as the moths

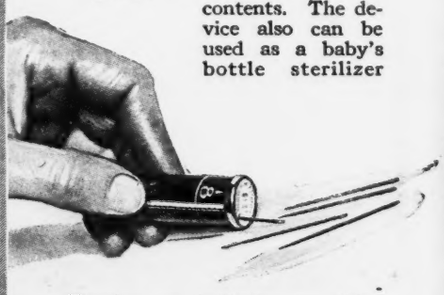
Foot pressure on a lever swings open this sanitary refuse can. A counterweight swings the can back under the cover

This wire egg rack is designed to prevent eggs from cracking when inserted in boiling water. The handle attachment spares the fingers. The device is collapsible

Here is a splashless colander. The under part of the cover has a perforated disk that presses the water from the contents. The device also can be used as a baby's bottle sterilizer

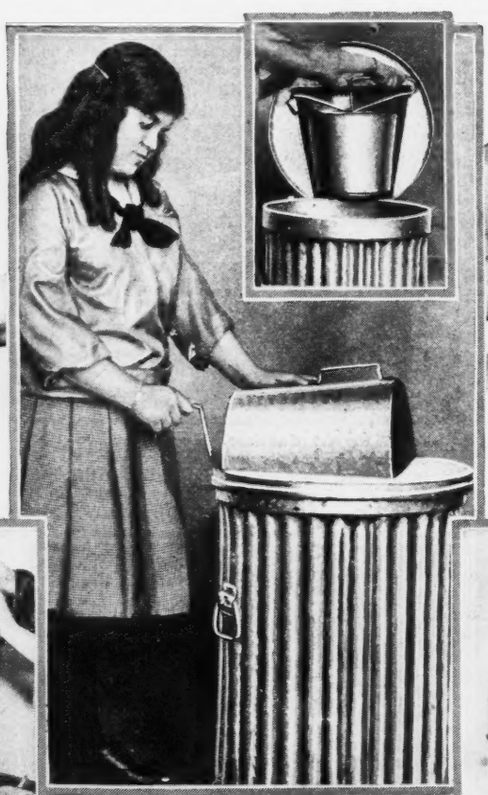


This dusting mitten can't slip off, it is claimed, because of glovelike compartments inside



Turning an indicator on this metal needlecase to the desired number, then tipping the case, delivers the size needle you want

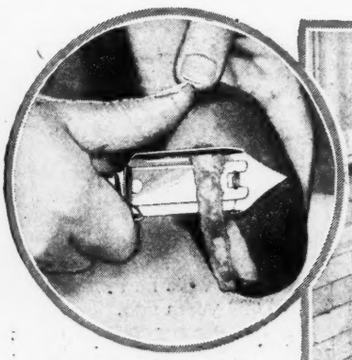
Dishes are washed simply by turning the handle of this machine containing boiling water and washing powder



This combination sifter and ash-can is said to be dustless. A pail filled with ashes is inserted in the lid and covered by a sieve. Turning a handle revolves the pail

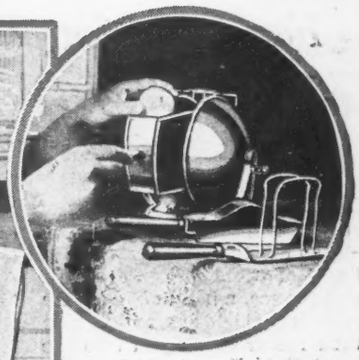
A small electric heater attached to an electric fan can be used for drying the hair, drying clothes or heating a small room

to Lighten the Housewife's Tasks



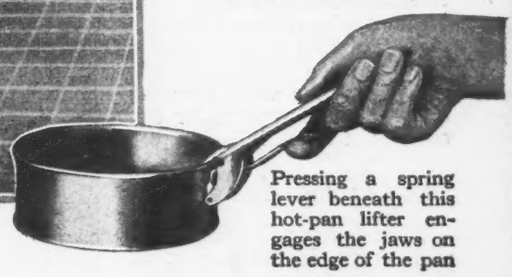
Used safety razor blades that otherwise would be thrown away fit in this ingenious potato peeler almost instantly, insuring a keen edge always. A safety guard over the blade protects the thumb of the worker

Backaches are eliminated from ironing day by a newly perfected electric ironer that can be operated while the housewife sits in a chair. A roller controlled by an electric button is said to iron clothing of all kinds, even starched garments



Boiling eggs without water is the feat claimed for a small electric cooker and toaster. The eggs are placed in a perforated container between two heat reflectors that radiate the heat evenly

Instead of flying into the face of the housewife, fish scales roll from under the blade of this scaler

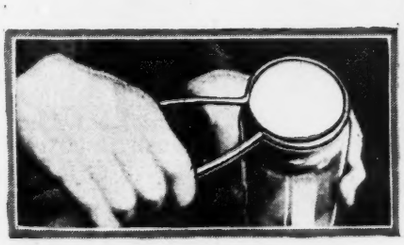


Pressing a spring lever beneath this hot-pan lifter engages the jaws on the edge of the pan

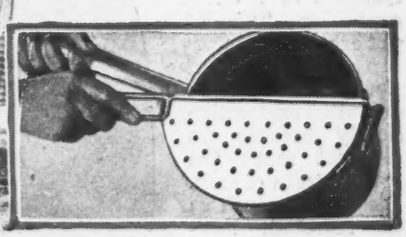
Here is a midget electric range that can be plugged into an ordinary apartment wall socket

One of the newest conveniences for the small apartment or home is an electric ironing machine that folds back out of the way into the kitchen or hall closet

An easily adjusted gear mechanism driven by a small motor turns the ice-cream freezer with ease



A wrench for removing preserve-jar caps without breaking them and for lifting jars from boiling water, consists of a gripping spring band with plier-like handles



A small hand colander consists of a perforated semicircular plate with a flange to hold it close against the edge of a pan when water is drained from vegetables

Science Nears Tomb of First Man

Fossils of Mongolia May Reveal Secret of Life

Expedition Starts Soon to Solve Age-Old Mystery

By Truman Stevens

INSPIRED by the success of their previous expedition, so startlingly productive of finds of tremendous scientific significance, a band of American scientists this spring will guide their motor cars again into the great Gobi Desert of Mongolia, seeking to wrest from the bosom of the earth a scientific solution of the supreme mystery of nature—the origin of man.

The expedition will be led by Roy Chapman Andrews, of the American Museum of Natural History, who returned recently from Mongolia after two years of exploration that resulted in what have been called the most important and spectacular discoveries of their kind.

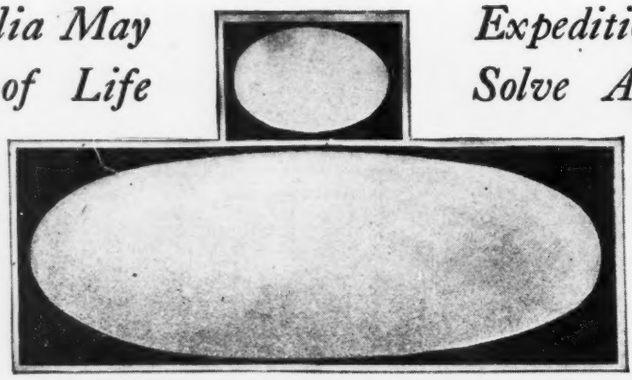
America and Asia Linked

These discoveries, scientists say, prove indubitably that North America and Asia at one time were linked by land, and supply all but direct evidence that central Asia was the fountainhead from which sprang human life. That Central Asia was the source of most of the other forms of animal life now on earth the recent expedition proved virtually beyond question.

In the search for evidence of the birthplace of man, the scientists will seek the fossilized bones of primitive men believed to have lain buried in the Mongolian rocks for millions of years. That the bones are there, the members of the expedition are certain.

"I believe unquestionably that Mongolia will yield the remains of primitive man," said Mr. Andrews recently, speaking through courtesy of the American Museum of Natural History and *Asia Magazine*, joint sponsors of his first expedition. "We did not exhume the bones of the progenitors of the human race on our initial exploration simply because we did not reach the proper strata of rock. We learned much as we searched, however, and I am confident that on our next trip we shall get there."

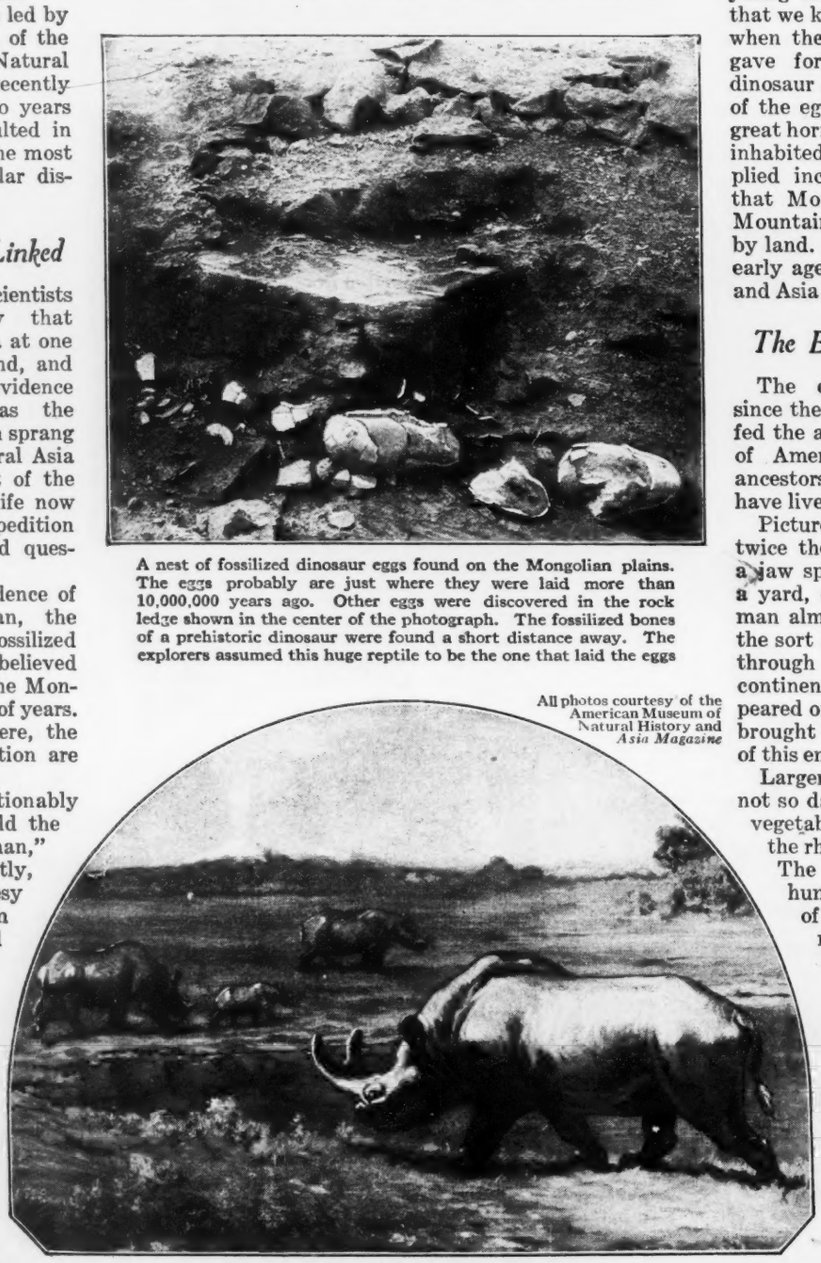
Probably the most important scientific treasures unearthed were 25 dinosaur eggs, some of them containing embryo dinosaurs. A number of eggs were found in the nest where they were laid more than 10,000,000 years ago.



A dinosaur egg compared with a hen's egg. The length of the dinosaur egg (below) is eight inches; the diameter 2 4/5 inches. Note its elongated shape as compared with the oval hen's egg (above), which is about 2¼ inches long and 17/16 inch in diameter

A nest of fossilized dinosaur eggs found on the Mongolian plains. The eggs probably are just where they were laid more than 10,000,000 years ago. Other eggs were discovered in the rock ledge shown in the center of the photograph. The fossilized bones of a prehistoric dinosaur were found a short distance away. The explorers assumed this huge reptile to be the one that laid the eggs

All photos courtesy of the American Museum of Natural History and *Asia Magazine*



Restoration of the giant browsing rhinoceros which, as far as science knows, was the largest mammal that ever walked the earth. It was as large as a locomotive. Its fossilized skull was exhumed in Mongolia by the Andrews expedition and has been placed on exhibition at the American Museum of Natural History, in New York City

This discovery was the first revelation science has had that dinosaurs — huge lizard - like creatures that walked the earth eons before the dawn of history —laid eggs and cared for their young as do the tiny reptiles that we know today. Moreover, when the rocks about the nest gave forth 70 skulls of the dinosaur *Proteceratops*, the layer of the eggs and ancestor of the great horned dinosaurs that once inhabited America, they supplied incontrovertible evidence that Mongolia and the Rocky Mountains once were connected by land. In other words, in the early age of mammals, America and Asia made up one continent.

The Birthplace of Man?

The explorers reason that since the Mongolian plains once fed the ancestors of the animals of America and Europe, the ancestors of man likewise must have lived there.

Picture a hyena, more than twice the size of a horse, with a jaw spread of little less than a yard, capable of devouring a man almost in a gulp! That is the sort of creature that stalked through the American-Asiatic continent when man first appeared on earth. The expedition brought back with it the skull of this enormous animal.

Larger still, though probably not so dangerous, since it was a vegetable-eating animal, was the rhinoceros of that period. The expedition also exhumed the skull of one of these—the largest land mammal known to science.

Twenty skulls of a huge beast that science knows only as *Titanotheres* likewise were discovered, additional evidence that America and Asia once were united; for the first fossilized specimen of this beast was found some time ago in South Dakota.

Quite as amazing in its relation to the weird changes that the land mass of the

earth has undergone since the beginning of creation, was another find—a vast deposit of fossils of invertebrate sea creatures. These indicated that a wide sea-way extended straight through Mongolia in what geologists call the Permian times—when most of the northern hemisphere was below sea level.

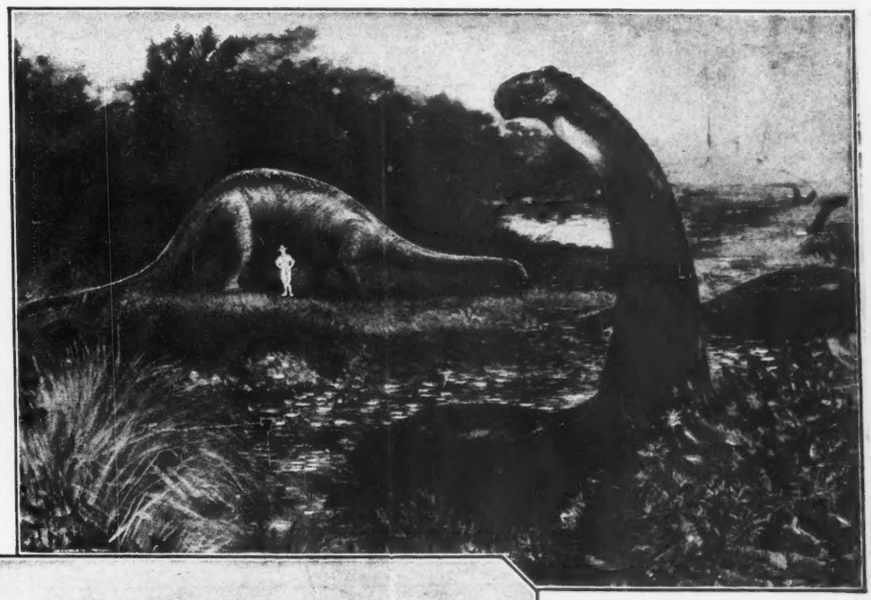
Nine Tons of Fossils Found

The expedition obtained countless specimens of living animals, birds, fishes, and reptiles. In all, more than nine tons of fossils were exhumed, the largest collection ever taken by any expedition in a single season. In addition, a vast area was mapped, important geological discoveries were made, and the longest geological cross section ever completed in reconnaissance was executed by the scientists in their preliminary survey of the country.

Ten years' work, says Mr. Andrews, was accomplished in two summers of five months each, made possible by the fact that the expedition traveled in motor cars—supported by a caravan of 75 camels. These carried gasoline, food and other supplies to the camp sites. Thus the expedition used one of the oldest and one of the newest methods of transportation known to man. The automobiles covered from 125 to 150 miles a day, and amazed the natives, whose laden camels can negotiate only about 15 miles in a day's travel.

"Our expedition," says Mr. Andrews, "was a triumph of American enterprise—not so much on the part of us who performed the work of exploration as of those who made it possible. It was an American, Professor Henry Fairfield Osborn, president of the American Museum, who in 1900 advanced the theory that the origin of life might be found in central Asia. It was characteristic of the adventurous spirit of the American business man and his interest in science that $200,000 was advanced to back that theory. Our equipment was supplied us. Our way was made smooth. We had only to achieve our objective."

Walter Granger preparing a fossil for shipment. He is strengthening it with paste bandages, made of flour and old clothes



Dinosaurs as they appeared in prehistoric ages—a scientific restoration from fossilized remains. This huge lizard-like creature measured from 60 to 80 feet from head to tail. The figure in white shows the comparative size of a man

Left to right: Prof. Henry Fairfield Osborn, president of the American Museum of Natural History; Roy Chapman Andrews, leader of the expedition, and Walter Granger, chief paleontologist, standing on the rim of a pit from which a large number of dinosaur bones were unearthed. Are the bones of original man close by?

Pushing the expedition to its successful completion, however, was by no means as simple a task as Mr. Andrews modestly pictures it. The scientists met with no thrilling adventures, he declares; yet it is a matter of record that on several occasions the members of the expedition were attacked by the giant, savage dogs that infest the country, probably the fiercest creatures on earth. The dogs feed almost entirely on human flesh, due to the Mongol custom of casting the bodies of their dead out on the plains.

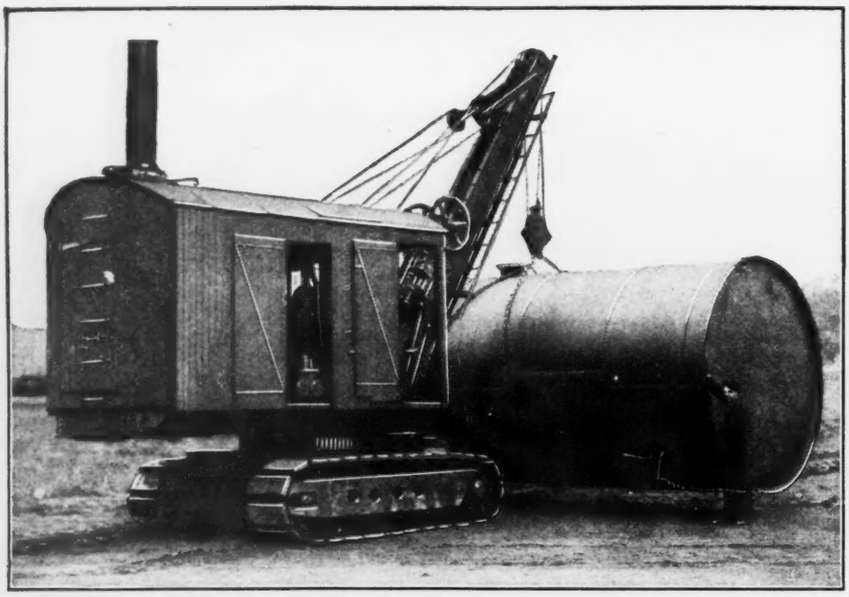
On one occasion a pack of fourteen of these savage brutes attacked Mr. and Mrs. Andrews as they slept in the open at night. A lucky shot from a small-caliber rifle killed the leader of the pack, and, while the other dogs devoured their fallen leader, Mr. Andrews was able to get a larger rifle and kill enough of them to send the whole pack scurrying away in panic.

Venomous vipers, that constantly lodged themselves in the shoes, socks, and clothing of the explorers, constituted another danger with which the expedition contended. At first the explorers encountered hostility from the natives, who could not believe that an expedition of more than 30 members, traveling in "wind cars" (*chi-churs*), would invade the country for any such absurd purpose as to "hunt bones." This hostility was not manifested in any violent form, and it subsided rapidly when the natives understood that the quest of fossils actually was the only purpose of the white foreigners.

The leader of this epochal expedition is a slender, scholarly appearing, soft-voiced, and gentle-mannered man of 39, a zoologist, whose place, one would say, would be in university halls rather than in pushing perilous exploration through unknown lands. Yet since 1908 he has spent more of his time in adventurous research in remote regions of the world—Alaska, Borneo, Corea, China—than in civilization. Until he was placed in charge of the expedition into Central Asia, his specialty had been hunting whales. He was the only naturalist who devoted himself exclusively to that thrilling and hazardous quest, and he has faced death many times.

Search Will Last Five Years

And now Mr. Andrews is eager, impatient even, to return to Mongolia, where he will give five years to completing his search for what he calls the "paleontologic Garden of Eden." No expedition of history—not even the numerous heroic dashes for the North Pole, or the first daring voyage of Columbus—ever was fraught with more thrilling and dramatic possibilities than are contained in the prospect of bridging the gulf of millions of years and solving for man the riddle of his origin.



STEAM SHOVEL CARRIES HUGE TANK

A STEAM shovel mounted on endless treads recently solved uniquely a knotty problem confronting a contractor who, in building a gasoline filling station, found it necessary to move a 15,000-gallon steel storage tank, weighing nearly six tons, a quarter of a mile. Because of the enormous weight of the tank and its large dimensions—25 feet long by nine feet in diameter—ordinary hauling methods were out of the question.

A steam shovel near the scene gave the contractor his inspiration. After the dipper and dipper handle of the shovel had been removed, a chain cradle placed around the tank was made fast to the sheave block. The now shovelless shovel easily lifted the tank clear of the ground. With a man walking beside each end to prevent undue swinging, the great tank was carried the quarter mile and placed in a 12-foot excavation.

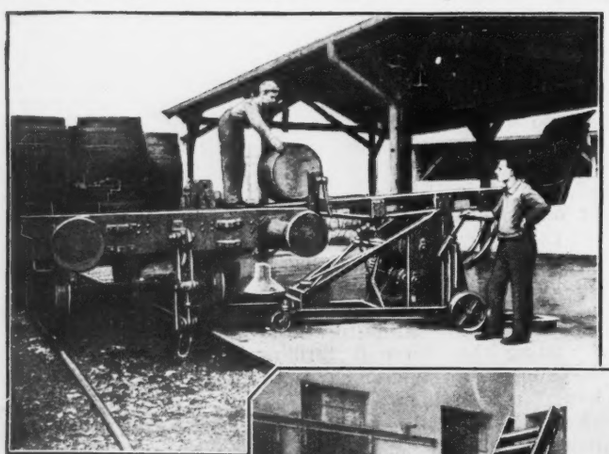
The entire operation required, it is said, less than one hour.

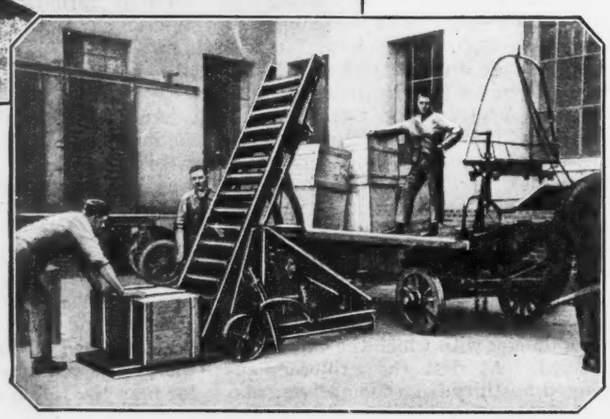
MECHANICAL LOADER IS LABOR SAVER

OPERATING on the seesaw principle, a loading truck invented in Germany is said to enable one or two workmen to accomplish the work of six. Containers weighing half a ton can be handled by one man, aided by the machine, it is claimed.

A steel frame supporting a skid, consisting of a series of roller bearings, is mounted seesaw fashion on a stout support that rests on a three-wheel truck. The loading frame or skid has at one end a platform that rests on the ground to receive the load.

The workman, turning a crank, raises the loading skid until the end opposite the load is lower than the fulcrum of the seesaw. The load then rolls down the rollers of the skid to the car or truck. The loader can be wheeled easily from place to place. During loading it is held stationary by brakes.

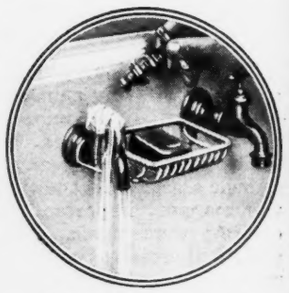




Above: The skid elevated to an inclined position, permitting lifted barrels to be rolled on roller bearings to the truck. At the right: Loading a packing case on the lift platform. When the operator turns a crank, the pivoted seesaw skid is elevated to the slightly inclined position shown above

How to Shut Off Water in Repairing Faucet

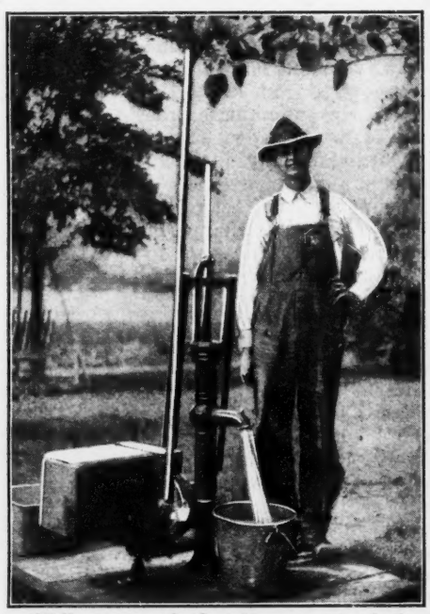
THE problem of the leaking water faucet is one that presents itself occasionally to almost every home owner. Usually the cause of the leak lies in a washer that has become worn. To replace it with a new washer is a simple job; but first the water must be turned off or the pressure in the pipes reduced.



Reduced pressure permits work on the faucet

In case it is found impossible to shut off the water from the house, a plan recommended by experts is to turn on all the faucets in the house. This will reduce the pressure sufficiently to permit work on the damaged faucet.

Electric Motor Drives the Old Farm Pump



Well pump with electric motor attached

USE of electric power on the farm has progressed to a point where even the old-time hand pump is driven by motor.

Designed especially for this purpose, a newly perfected motor of one quarter or one half horsepower, inclosed by a rust-resisting metal box, drives the pump at 35 strokes a minute. The length of the stroke can be adjusted to accommodate various well depths and cylinder lengths.

Either alternating or direct current can be used. A pushbutton starts and stops the pumping. The mechanism can be installed in an hour, it is claimed, and soon will pay for itself in saving the time and labor of the farmer.

THE Editor will be glad to supply, wherever possible, the names and addresses of manufacturers of devices mentioned in this issue.

Every Pile of Tin Cans Is an Iron Mine

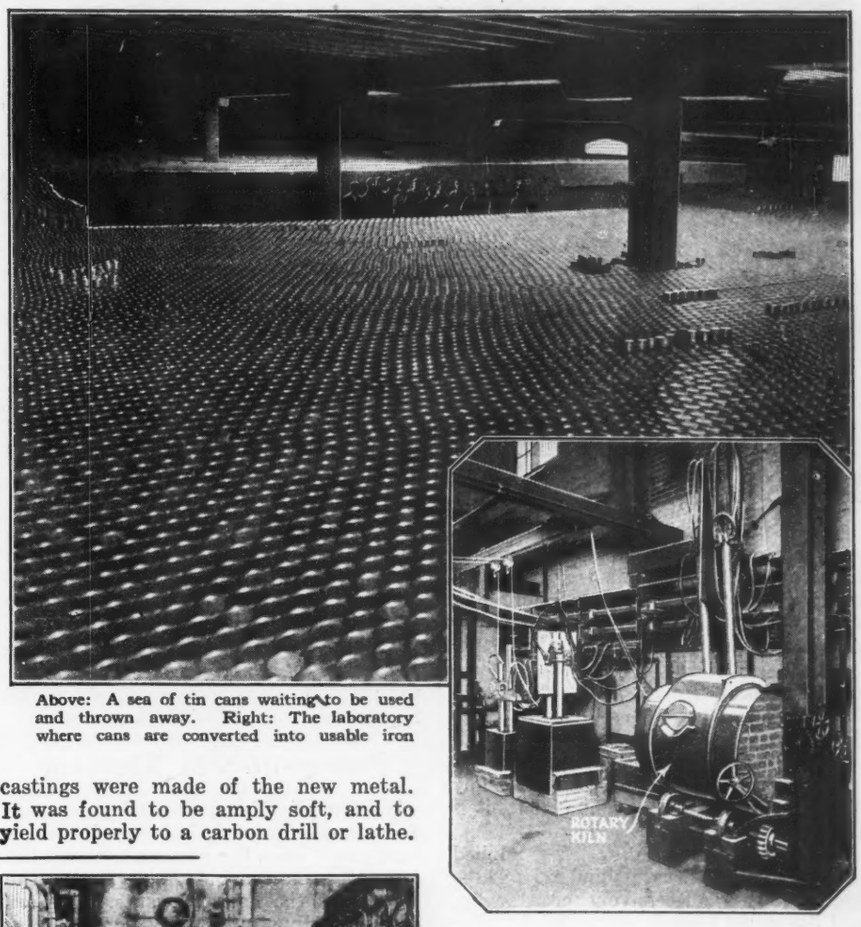
THAT sorry procession of empty tin cans that passes continually through your back door to ignominious oblivion soon may be knocking at your front door in the form of brackets for your walls, sash weights for your windows, griddles for your kitchen stove, and grates for your furnace.

In a series of experiments recently concluded by the Northwest Experiment Station of the Bureau of Mines, Seattle, the Great American Can has been converted successfully into synthetic iron for any use to which ordinary pig iron can be put.

The millions of cans that are wasted each year (from 160 to 200 are used by each of the 25,000,000 families in the United States) contain very little tin. All but one per cent is iron. The problem of salvaging them heretofore has been the difficulty of separating the tin from the iron so that the latter might be used.

The melting temperature of tin is 232° C., while that of iron is 1500° C. Attempts to melt all the tin off proved unsuccessful. But the Seattle experimenters overcame this limitation by adding scrap iron to the metal obtained from melting the can scrap, thus reducing the proportion of tin by diluting it.

Heavy sections and thin ornamental castings were made of the new metal. It was found to be amply soft, and to yield properly to a carbon drill or lathe.



Above: A sea of tin cans waiting to be used and thrown away. Right: The laboratory where cans are converted into usable iron

Small Tractor Converted into Power Shovel

THE small tractor can be converted quickly into a diminutive and mobile power shovel when equipped with a recently patented attachment consisting of a broad shovel, holding half a cubic yard, and fastened to the front and rear axles of the tractor. The machine is especially useful on small jobs such as digging cellars, ditching, loading wagons or shoveling snow.

Power for raising and lowering the shovel is supplied by the tractor engine through a pulley attached to the right side of the tractor. A steel rope passing around a drum at the rear, operated by a trip lever beside the driver, manipulates the shovel.

The driver sends the tractor forward in low gear. A lever lowers and raises the shovel as required.

Tractor-power shovel used for excavating

One Man Controls Great U. S. Dreadnaught

THE brain of Uncle Sam's mighty dreadnaught *Colorado* is in the little room shown above. From it every movement of the great war-ship can be governed by one man through a marvelous electrical control system. The long levers control 30,000-horsepower electric propelling motors. The short handles control the throttle valves of giant steam turbines. These turbines drive electric generators that provide the power for the electric motors. The motors, in their turn, drive the great propeller shafts.

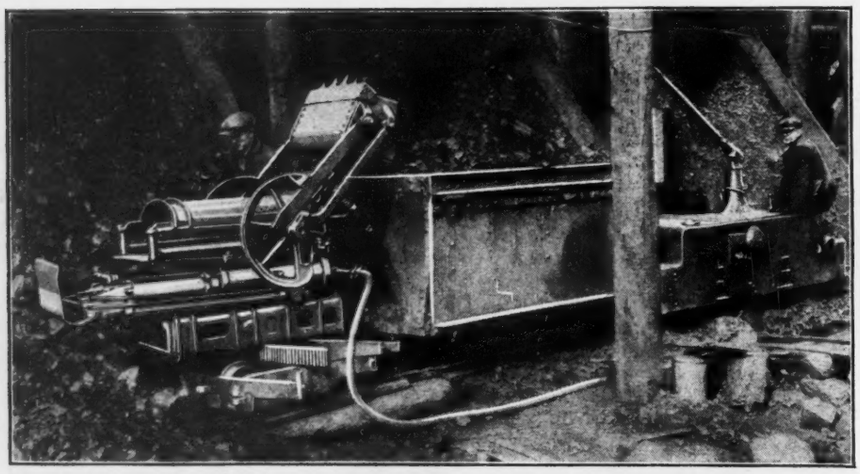
One-man control is the last word in the navigation of battle-ships. Heretofore six men have been required as a control-room crew.

Car-Drawn Mower Cuts Weeds along Tracks

WEEDS along the tracks of an interurban trolley company of Rockford, Ill., caused considerable trouble and expense every summer, until an employee of the company hit upon the idea of hitching a mowing machine, of the type commonly used on the small farm, to a trolley car and hauling it over the right of way.

By the new arrangement, the mowing machine is equipped with flanged wheels to fit the tracks and the tongue of the machine is attached to the rear of a car. As the mower is hauled along the tracks, the cutting blades can be raised or lowered.

Mowing weeds along the right of way



DIGS AND LOADS BY COMPRESSED AIR

AN UNUSUAL digging machine that combines the processes of shoveling and loading is finding its way into hundreds of mining and construction jobs. It is operated and driven entirely by compressed air.

The speed of the loading can be controlled so as to throw the material to the farther end of a long car, or merely to drop it into a short one.

The mechanical shovel will dump its load into the center of the car from any position, even extreme right or left, it is claimed.

Compressed-air power is applied through direct thrust cylinders. Three control levers successively crowd, dig, and dump the shovel.

The two middle cylinders, acting as one, which do the main digging, are provided with cataract oil escapement plunger pistons. This arrangement is declared to give a steady and controlled but fast movement, from the first of crowding to the last of dumping, permitting no building up of pressure and consequent jumping, or throwing out of the load.

Penny-in-Slot Elevator

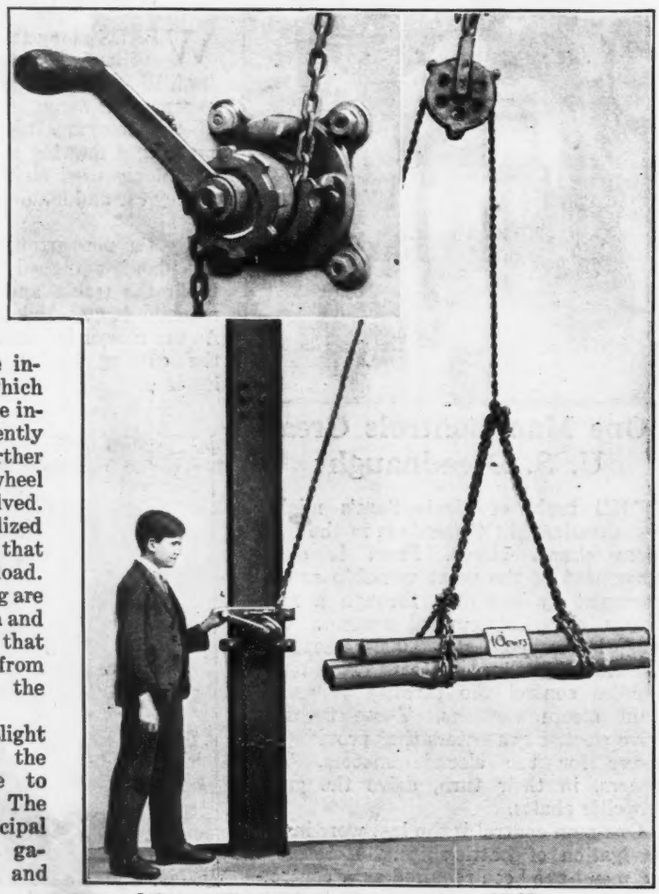
A PENNY-IN-THE-SLOT automatic elevator recently has been invented. Inserting a coin, the passenger enters the car and presses a button displaying the number of the floor he wants. The car automatically stops at that floor.

BOY LIFTS HALF A TON WITH GEAR

THIS novel form of hand lifting gear, by which a small boy may raise half a ton weight as high as 100 feet, has been devised by an English manufacturer.

The apparatus is operated by turning a short handle, bolted to a sprocket wheel. This wheel has one less tooth than the internal gear with which it is connected. The internal gear consequently advances slightly farther than the external wheel as the latter is revolved. This difference is utilized in winding a chain that lifts the desired load. Braking and lowering are controlled by a drum and pawl mechanism that prevents the hoist from overrunning when the handle is released.

A comparatively slight force applied to the handle will suffice to raise a great weight. The device finds its principal use in warehouses, garages, motor works, and on small craft.



Lifting 1000 pounds by the gear shown in the inset

Useful Hand Vise Lathe for Shop or Garage

DESIGNED especially for garage owners, auto owners, farmers, and machinists, a small but versatile hand vise lathe, recently invented, will make from bar stock such articles as milled studs, setscrews, cap screws, pins, and many other special screws and studs without using an engine lathe or automatic screw machine. The tool also winds wire springs with any pitch desired.

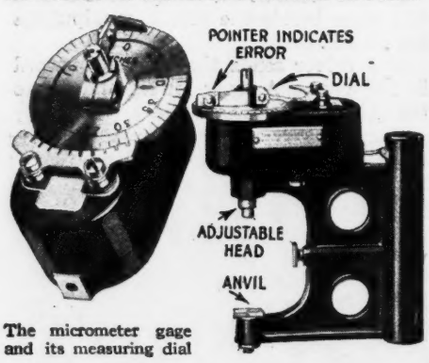
The hand vise lathe

Bar stock up to and including one inch in diameter can be handled. Any required length of screw, stud or spring can be made easily, it is said. Perfect accuracy is claimed. Since the device is hand-fed, the operator can make a fine or heavy cut as the occasion requires.

A New Comparator Gage

INDICATING to the thousandth of an inch any variation of a piece of work from a precise standard, a new comparator gage has been designed to supplant the snap and limit gage in repetition or production work.

The gage is set so that if the work measured is exactly standard size, it will give a zero reading. The slightest deviations from the standard are shown on a dial.



The micrometer gage and its measuring dial

In operation, the dial is turned back sufficiently to allow the work to clear the head of a measuring spindle. The spindle is held by an automatic brake. As the work being measured touches a releasing button, the brake is released and the measuring spindle is rotated by a driving spring until it contacts with the work. In this contact position it is locked and the reading appears on the dial.

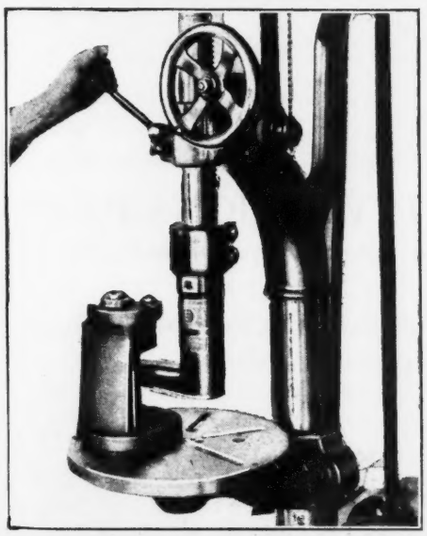
ENDLESS TREAD ENGINE PULLS SLED TRAIN OF LOGS

This logging sled train is hauled over the snow by a steam locomotive running on endless treads. The engine pulls 15 "cars"

THE alternative of a costly winter shutdown or the almost as costly use of an army of horses and drivers is circumvented by a northern lumber company through the use of endless tread steam engines and sled trains. Fifteen heavily loaded cars of logs can be hauled at a time over the snow by the steam tractor, which equals the work of 60 teams and their drivers. Moreover, the engine burns wood, while the horses ate costly oats.

The main body of the engine runs on endless treads and the forward part is shod with sleds. The cars run on sleds. An engineer, a fireman, and four lumberjacks can operate one of the trains over the long distances from forest to mill.

Offset Drill Bores Holes in Awkward Places



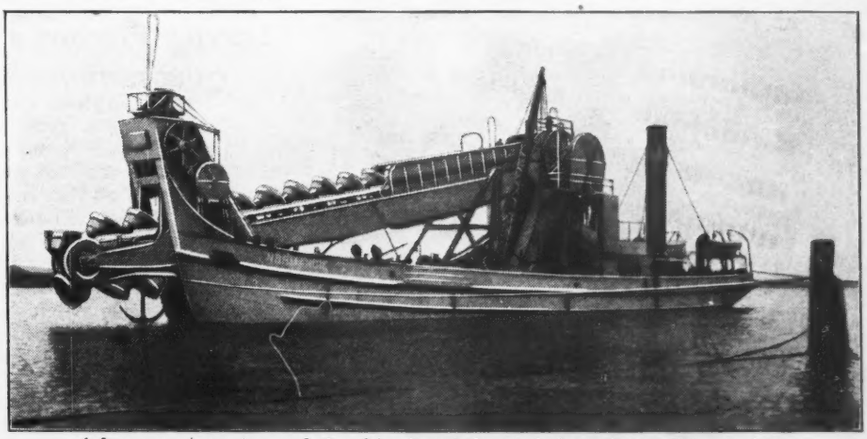
AN OFFSET drilling attachment has been perfected by a concern in Bridgeport, Conn., to overcome a difficulty that mechanics often encounter—that of drilling and counterboring holes in unusual and out-of-the-way places where the usual machines will not serve the purpose.

The attachment is so arranged that it may be swiveled around the center of the drill press spindle to the most convenient position. The rotation of the drill spindle is transmitted to the vertical drilling tool at the end of the offset through a square shaft.

The extremely small distance between the tool point and the top of the offset arm permits operation in the most cramped corners.

DREDGING WITH A CHAIN OF BUCKETS

OPERATING on the endless chain principle, this new dredger is said to represent a distinct improvement over the usual suction type. Digging buckets in an endless chain move about a huge shaft that is lowered diagonally into the water through a well in the bow of the dredging barge, as shown below.



A huge arm carrying a chain of buckets is lowered through a well in the bow

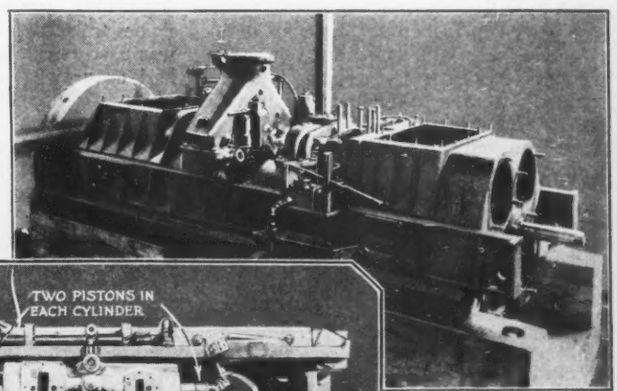
NEW DIESEL ENGINE HAS DISK DRIVE

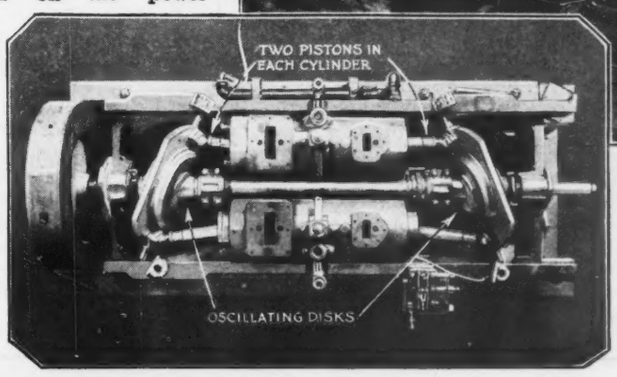
A RADICAL departure in Diesel marine engine design is found in a new crankless, two-cylinder machine utilizing the principle of the oscillating disk to transform reciprocating into rotary motion.

Each of the two cylinders has two pistons, one at each end, attached through ball-and-socket joints to the oscillating disks or thrust plates. While the pistons of one cylinder are moving inward on the compression stroke, those of the other cylinder are moving outward on the power stroke. The intake is on the power stroke, when a jet of oil is shot into the cylinder and mixed with air.

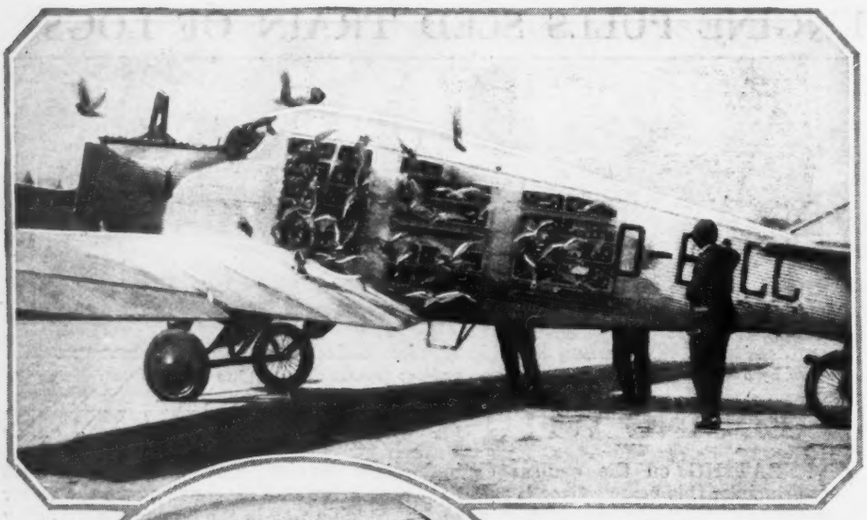
The power stroke of the pistons in one cylinder forces the pistons of the opposite cylinder together, compressing and exploding the gaseous mixture.

Pressure of the pistons on the sides of the tilted disks operate the drive shaft.





Above: General view of a light and powerful marine Diesel engine of the new type, showing hand lever for producing initial oil pressure. At the left: Plan of engine, showing arrangement of cylinders and oscillating disks that exert a thrust on the drive shaft



Airplane Transports Carrier Pigeons

SUCCESSFUL use of the airplane in transporting carrier pigeons was demonstrated recently at an aerodrome at Bourget, near Paris, France, where a machine especially designed for the purpose arrived safely from Ghent, Belgium. The upper photograph shows the pigeons being released. Part of the immense pigeon house in the fuselage is shown at the left.

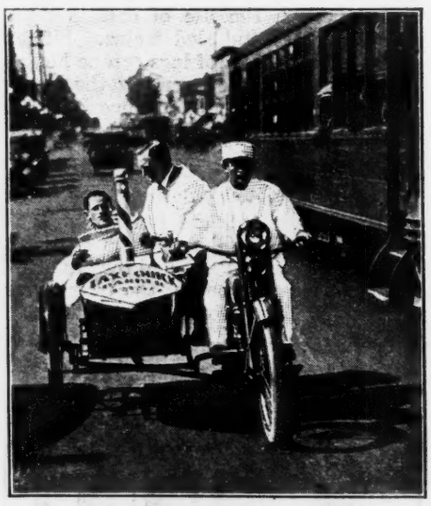
This method insures good cage ventilation.

A Shave at High Speed by Motorcycle Barber

NO LONGER need the hurried business man slash ruthlessly at his face in the morning in a desperate race against time to catch the 8:20 train. A motorcycle barber shop, in which he can enjoy all the comforts of a clean shave by an expert barber while he speeds along the streets on the way to his office, is the latest motorized novelty to be introduced at Los Angeles, Calif.

The customer sits in a motorcycle side car, which is equipped with an extra seat for the barber just behind the driver's seat. A small electric heater provides plenty of hot water for the shave.

A regulation barber pole surmounts the hood of the sidecar.



The motorcycle barber shop: Giving the business man a clean shave on the way to work. Note barber pole in front of car

CONTEST WINNERS TELL HOW THEIR INVENTIONS PAID

The prize-winning letters in the POPULAR SCIENCE MONTHLY contest, "What a Small Invention Did for Me"

First Prize, $20

By John Boyd, Flint, Mich.

WHEN I had an opportunity to go on a bench job in an automobile factory, I determined to make good. My mettle was challenged, because my predecessor had been unable to produce up to expectations.

I analyzed the problem. Of the four operations involved on each piece, the second and third caused the trouble.

The second was to loosen a nut on a bolt, it being necessary to hold the bolt head. I drove a socket wrench into the wooden bench. Thus I could put the bolt head into the socket and have both hands free for loosening. This cut in half the time required.

The third operation was to turn a collar held by this bolt until it was alined with a second collar. The first invariably was stuck with dried paint and had to be hammered into place. I made a U-shaped bracket and set the collar in it. Then I could turn the casing in the collar, which was equivalent to turning the collar itself.

Second Prize, $10

By C. R. Mullin, Minneapolis, Minn.

IN THE newspaper office where I began as a printer's devil, the press was used long after the size of the paper had outgrown it. The capacity of the press was an eight-page paper, but 12 pages was the usual size and special editions often were much larger.

This meant that the paper had to be printed in two parts, one being inserted in the other by hand. The room was very small, so that it was seriously crowded at press time by this work. Carrying the papers into another room would have been too costly in time.

So I picked up an old tape roller and the necessary tapes around the shop and built an extension on the outlet of the press. This carried the papers to an extra table, about two feet away. As the papers came from the press with the proper edge toward the workers, two persons were able to do the work of stuffing. This required but one table.

Third Prize, $5

By Howard W. Reid, Detroit, Mich.

EACH week our plant accumulates 1000 pounds of yarn through which are twisted strands of copper wire. To salvage this by hand cost $13,000 a year.

I mounted two drafting rollers on a special frame. To each of these were fitted two grooved pulleys. A roller that could be moved at will was placed upon the drafting rollers. Back of the pulleys was a set of rotary rollers, fiber covered and mounted on a hollow shaft. This shaft had a grooved pulley, behind which was a sheet-iron protector with a hole directly opposite the hollow shaft. Beneath the roller mounting were the drive mechanism gears and a small motor. Web bands served for drives.

The yarn was hooked in a wire eyelet and dropped down as the other end was passed into the rotary roller and started through the drafting rollers. This kept the yarn from being tangled by the whirling of the rollers.

World's Largest Vacuum Tube Perfect Model

THE world's largest vacuum tube—a complete working model of the well known dry cell tube that brought radio within the grasp of the average American—was constructed by an electrical manufacturing concern for display purposes. With its filament lighted to full brilliance, it presents a most attractive picture. It need hardly be mentioned, however, that the electricity it consumes requires a source of current far beyond the limit of such a dry cell as is used in a radio receiver.

Just try to picture the size of the radio set in which several tubes of these proportions could be operated.

Giant model of dry cell radio tube

Doctor Says Auto Driving Makes Us Pigeon-Toed

AS A result of continual automobile driving, Americans are becoming pigeon-toed, according to the statement of Dr. Carl Hunt, of New York City, after extensive research to determine the cause of a marked tendency to "toe in" on the part of a large percentage of the population in large cities. Complaints of pains in the right foot, which are becoming common, also are attributed by him to the same cause.

"Automobile drivers are developing a new form of foot trouble that in many cases becomes actual deformity," says Dr. Hunt. "Ever since the advent of the foot accelerator, my car-driving patients, in ever increasing numbers, have complained of pains in the outer side of the middle third of the right foot, particularly when walking. In most cases I have found that with correction of the position of the foot on the accelerator, manual manipulations, simple exercises, and properly fitting shoes, the trouble has disappeared."

Brothers Hike across Bay on Water Shoes

HIKING across San Francisco Bay recently, A. N. Sheldon, inventor of ingenious water shoes that made the feat possible, with his brother scored man's latest conquest of the water.

These shoes are 10 feet long and 14 inches wide, and of pontoon construction. They are walked with much as one walks with snowshoes. A top framework prevents the pontoons from spreading sidewise, at the same time accommodating the alternation of the stride. Handlebars aid in steering the course, which, although slow, is said to be safe and certain.

The decks of the "shoe pontoons" are covered, except for four small openings just large enough for the two operators to insert their feet.

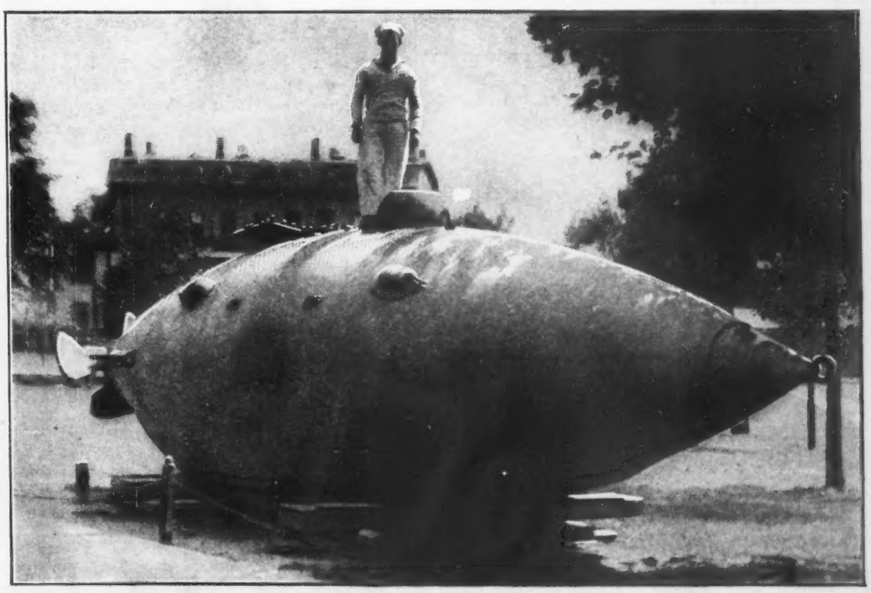
Bicycle saddles mounted on the framework enable the walkers to rest.

Side and front views of the water shoes

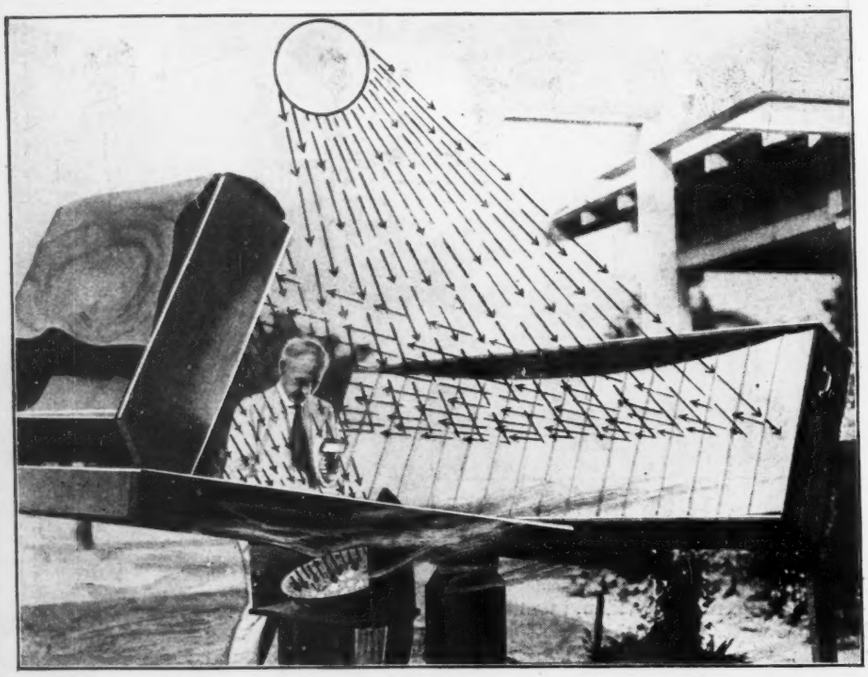
FOREFATHER OF MODERN SUBMARINES

HERE is one of the world's first submarine boats, built in 1864, by Messrs. Bushnell-Rice and Halstead of New Jersey, and now one of the relics on exhibition at the Brooklyn Navy Yard, New York.

It had a speed of four knots and was propelled by hand. A crew of 10 men was carried, although it was only 28 feet long and nine feet high. The cost was $60,000. The first successful submarine vessel was by David Bushnell in America in 1775.



The hand-propelled submarine, built in 1864, on exhibition at the Brooklyn Navy Yard, N. Y.



CONCENTRATED SUNSHINE MELTS ORE

CONCENTRATING sunlight to an intensity sufficient to melt ore, this reflecting apparatus, perfected recently by William Thomas, Los Angeles physicist, formerly an engineer with Thomas Edison, seems to mark an advance in the attempt to harness more sun energy.

The sunlight strikes sixteen 30-inch panes, each set at such an angle that the rays are reflected, considerably concentrated, upon another set of panes opposite. From these the rays focus on a spot six inches square.

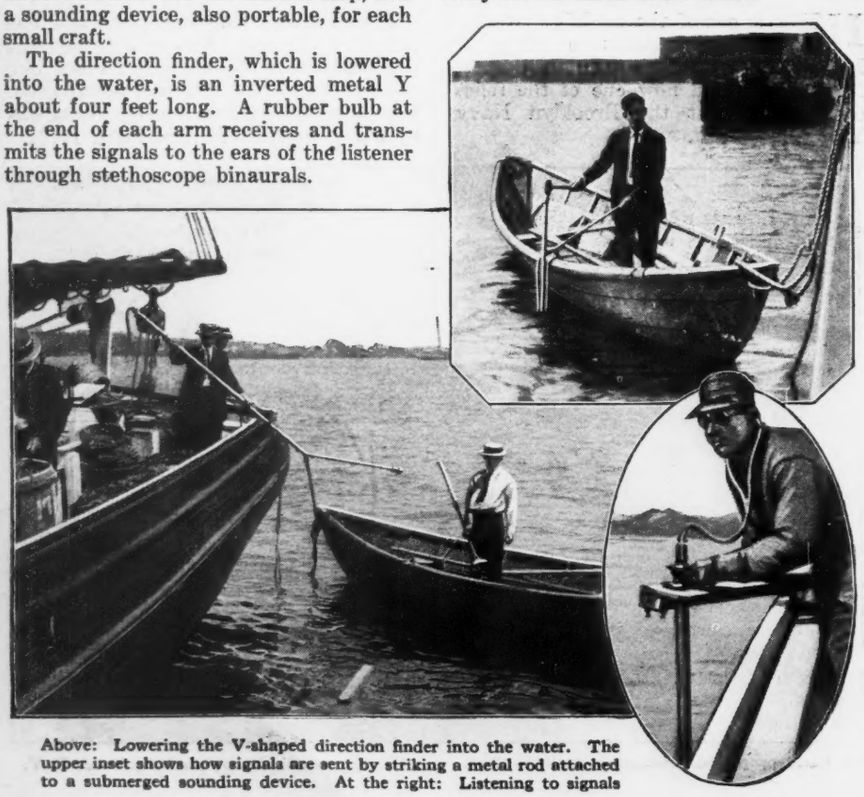
Thus, the heat normally distributed over 24 square feet is concentrated to fall upon an area of 36 square inches.

UNDERWATER SIGNALS RESCUE BOATS

TO LOCATE and rescue lifeboats or other small craft lost from their mother ships in fog or storm, a simple underwater signaling system has been perfected. It consists of a portable direction finder for the mother ship, and a sounding device, also portable, for each small craft.

The direction finder, which is lowered into the water, is an inverted metal Y about four feet long. A rubber bulb at the end of each arm receives and transmits the signals to the ears of the listener through stethoscope binaurals.

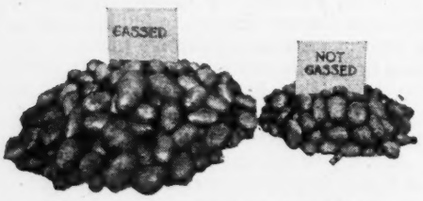
The sounder consists of an inverted metal cup at the end of a metal rod. The cup end is submerged, and the upper end of the rod is struck with a hammer. The sound waves thus produced are said to carry several miles under water.



Above: Lowering the V-shaped direction finder into the water. The upper inset shows how signals are sent by striking a metal rod attached to a submerged sounding device. At the right: Listening to signals

Carbonic-Acid Gas Said to Fertilize Gardens

INCREASES in vegetable yields ranging from 35 to 175 per cent are said to have been achieved recently by German agricultural experts through the use of carbonic-acid gas as a soil fertilizer.

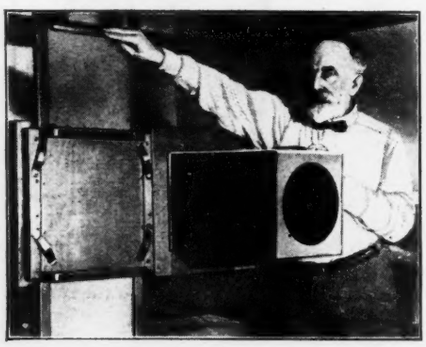


How the size of potatoes was increased by fertilizing them with carbonic-acid gas

Since carbonic-acid gas is formed in combustion, waste gas from a mine and foundry near Essen, Germany, was used in the experiments. After being purified, this gas was led through pipes with perforations to hothouses and open fields. In both cases astonishingly favorable results were reported.

Much more rapid development and a 70 per cent increase in yield are claimed to have resulted from supplying the gas to cucumbers. Tomatoes were said to be increased 275 per cent.

Largest Camera Lens Used to Photograph Stars



ONE of the world's largest cameras was made recently by the United States Bureau of Standards to photograph astronomical observations. It is six feet long, four feet wide, and 2½ feet high. It uses plates 11 by 14 inches. The lens is said to be the largest photographic camera lens ever manufactured in the United States.

Ocean Currents Measured by Floating Bottles

KNOWLEDGE of the direction and speed of ocean currents is of great importance to navigators. Since it is difficult to measure these directly, the United States Hydrographic Office accomplishes it approximately by means of what are known as "bottle papers." These are small paper slips with directions for their return to the proper authorities printed in several languages. Sealed in bottles, they are given to ships' captains, and thrown overboard. On them are written the time and place they are launched. After months or years they return to Washington. One drifted nearly across the Atlantic and back.

Potato Bugs Speared to Death by Enemies

AGAINST the devastating potato bug, the United States Department of Agriculture is marshaling an army of enemy soldier bugs, popularly known as "stink bugs."

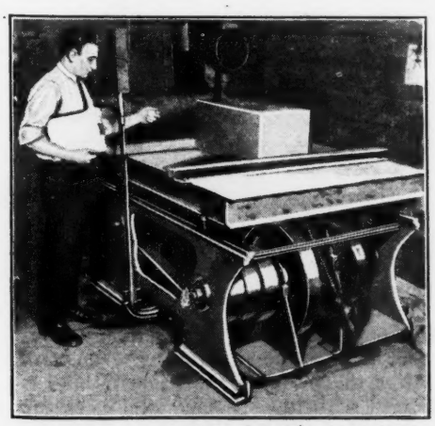
Every time a potato parasite clashes with one of these deadly antagonists, potato plants are just one bug safer. For the soldier bug usually wins. Advancing to the attack, he jabs a spearlike beak into a soft spot in his prey's armor. Barbs at the tips of the jaws keep the spear inserted. The doomed potato bug at first feigns death, then begins a frantic scrambling over obstacles to shake off its assailant. Exhaustion finally leaves the potato bug at the mercy of the soldier bug's appetite, which sates itself on the blood and juices of the victim.

Soldier bug feasting on potato bug

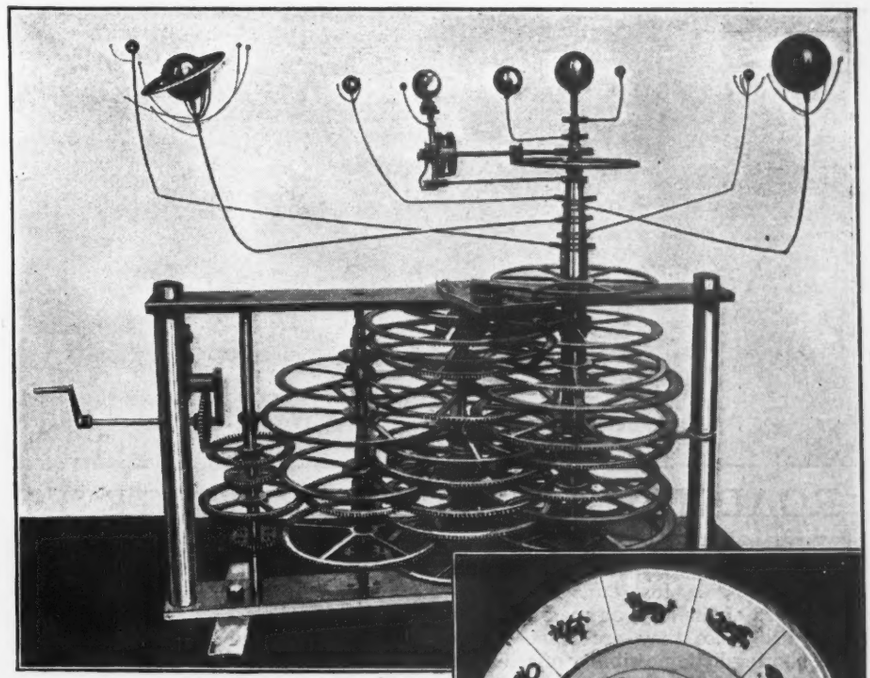
Jolting Machine Tests Strength of Boxes

SIMULATING the bumping and swaying of a moving freight car, a machine recently designed by the Forest Products Laboratory of the United States Department of Agriculture, tests the strength of box containers for merchandise in transportation.

A table to which the box being tested is attached moves backward and forward on wheels over a distance of several inches. The wheels roll on rails at each side. The shaking effect may be varied by accelerating or slowing the machine.



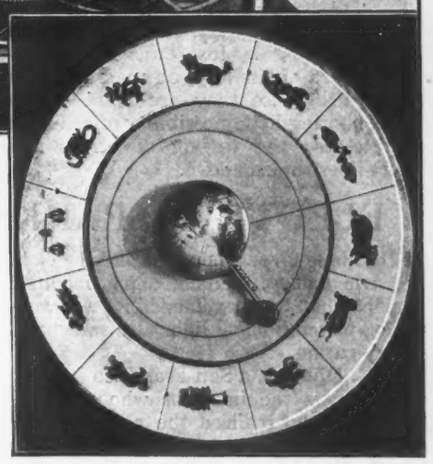
Testing a box on the shaking table



Clock Shows Movements of Planets and Satellites

AN AMAZINGLY intricate 10-dial astronomical clock that records minutely the movements of each planet and satellite of our solar system has been invented by Oswald Schulz of Berlin.

Since each of these bodies has a characteristic set of movements, this is an astonishing mechanical achievement. The clock has no springs and operates only while the crank shown at the side is turned. The upper illustration shows the stripped mechanism. The lower records the ecliptic rotation of the moon about the earth.



This dial shows the movement of the moon around the earth. Top: The solar clock, uncovered, showing the intricate mechanism

The inventor demonstrating his sun engine

Sun's Rays Bottled to Drive Steam Engine

BY CONVERTING the energy of sunlight into the energy of steam with an ingeniously contrived reflector, Bernard A. Grossman, a young New York physicist, believes he has found a method of bottling solar energy for use on a large scale in producing cheap power.

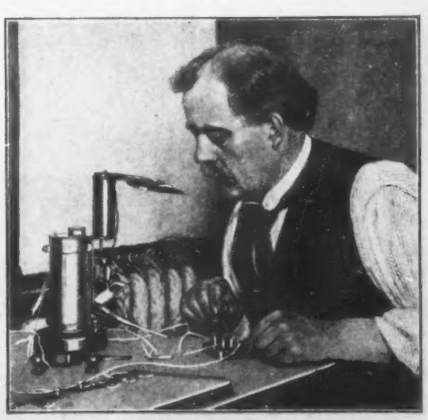
The reflector consists of a series of parabolic mirrors arranged in such a way that they concentrate sun rays upon a small boiler, producing steam. The energy thus produced, Grossman declares, may be translated into electrical energy by running a steam engine and generator.

Crime Suspects Tested by Detective Machine

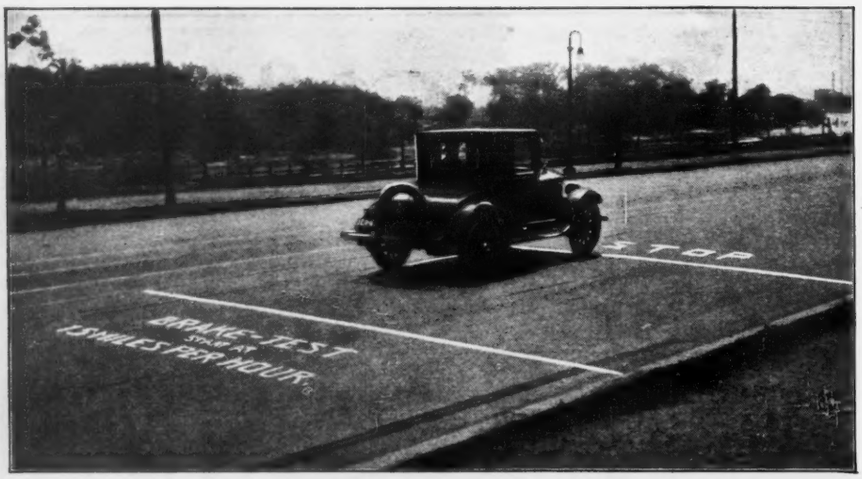
GUILTY secrets are said to be bared unerringly by a delicate "third degree" apparatus invented recently by Dr. Albert Schneider of the University of California.

The suspect places the forefinger of each hand on contacts from which run minute wires to a capillary electrometer, an arrangement of glass tubing. Through one tube runs a fine thread of mercury.

Fluctuations of the mercury are said to betray the suspect.



Doctor Schneider and his crime detector



ROAD LINES SIMPLIFY BRAKE TESTS

TESTING auto brakes is made easy for the motorist by traffic authorities of Hartford, Conn. Just outside the congested area of the city, on road stretches selected because they are smooth and level, offering little possibility of collision, are painted the testing directions and white lines shown above.

The lines are 20 feet apart. The driver is to cross the first line at exactly 15 miles an hour, applying his brakes full force at the instant of crossing. If he stops at or short of the second line, his brakes are in sound order.

The lines and directions are repainted at necessary intervals.

ELECTRIC SPARKS AS FOG SIGNALS

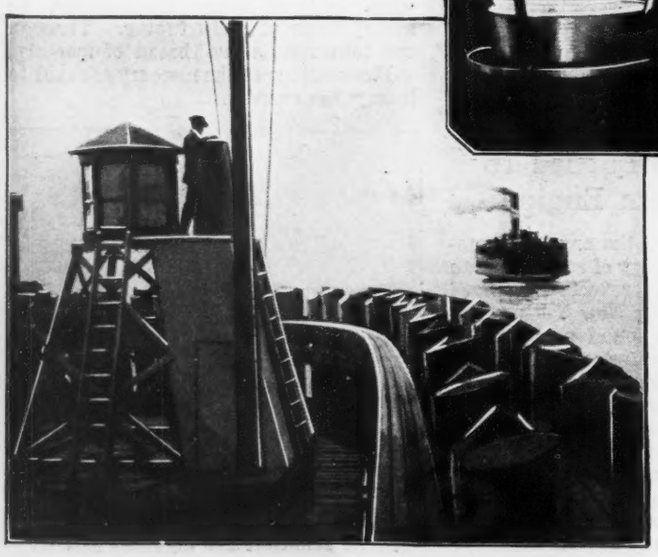
THE blue-green flash of a sparking electric trolley, piercing a fog, inspired an idea that has developed into a powerful fog-piercing signal light as a safeguard to navigation.

R. C. Douglas, a San Francisco jewelry salesman, is the inventor who saw the flash and who realized the possibility of using quickly drawn out electric sparks for effective fog-signal lights. Today the results of his ingenuity and patience are found on San Francisco ferries and pierheads, guiding ships through the fogs. The lights are said to penetrate dense fog more than 1000 feet beyond the reach of the eye, locating passing vessels.

A motor-driven gear mechanism in a hooded space at the top of the light raises and lowers a thick electrode upon the upturned tip of another electrode. These two electrodes form the make-and-break point of a 110-volt electric circuit. The periodically formed gap is drawn out or widened two or three inches as the current is leaping it. The flaming arc becomes remarkably active as it seeks to fill the widening space, simultaneously creating a penetrating, flashing fog light.

Douglas is continuing experiments with his invention, in an effort to increase still further the intensity of the light and thereby extend its usefulness.

Above: The inventor, with eyes protected by mask and goggles, experimenting with his new fog signal light to increase the intensity of electric flashes

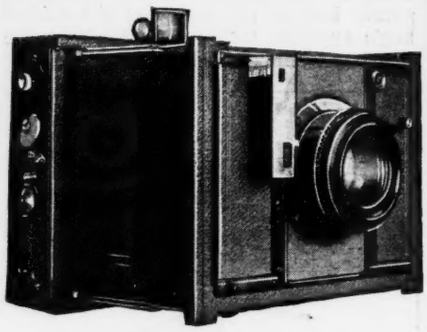


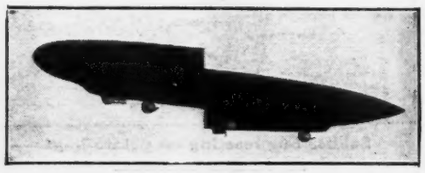
At the left: One of the lights set up on a pierhead at San Francisco to guide ferry-boats and other craft during heavy fogs

Camera Range Finder for Sharper Photographs

A PHOTOGRAPHIC range finder, using the principle that served gunners in the Great War, has been perfected in England. It is claimed to insure sharp photographs under favorable light conditions irrespective of the size of the camera lens aperture.

The invention is contained in a small metal box three inches high and seven eighths of an inch square, compact enough for the vest pocket, yet easily attached to a camera. Looking into the finder through the top aperture, the photographer sees two misplaced halves of an image, like those in the lower illustration. An adjusting screw at the side of the finder is manipulated to justify the halves. The distance of the object from the camera then can be read off on a scale and the camera focused accordingly.





Above: The range finder attached to a camera. Below: The reflected image of a distant dirigible. Range is determined by bringing the halves of the image together

Within the finder are two mirrors, one above the other. The bottom mirror is fixed, while a smaller one at the top is movable, and is adjusted by the screw. Each mirror reflects an image of a portion of the object to be photographed. If the mirrors are parallel, the two reflections do not fit together.

By turning the adjusting screw until the top mirror is at the correct angle to make the images fit, a pointer records the exact distance of the object that is being photographed.

Corrugated Blade Slices Potatoes for Frying

APPETIZING latticed potatoes for frying — potatoes cut in thin corrugated slices like the two shown in the illustration — can be made speedily with a handy cutter that rests on the top of the kitchen table. After the potatoes are peeled, they are forced with quick strokes against a sharp corrugated cutting blade.

Fishing Gun Casts Line without a Rod

MOTORISTS, campers, and hikers who may want to fish, but who do not wish to include a more or less cumbersome rod in their equipment, may enjoy the sport notwithstanding, through the invention of a rodless casting reel that has just been put on the market by a New York manufacturer. This may be described as a fishing gun containing a spring that shoots the line from the reel when a trigger is pressed. The fish may be played from the reel as with a rod. Accurate casting is possible from the shores of bays, lakes, or streams or into the surf, the makers declare.

The device is especially useful for those who desire to fish from boats. It weighs 19 ounces, is 9½ inches long, and has a capacity of 80 yards of line. The aluminum handle is hollow to permit the storing of bobbin, sinker, flies, and hooks. If desired, a rod may be used.

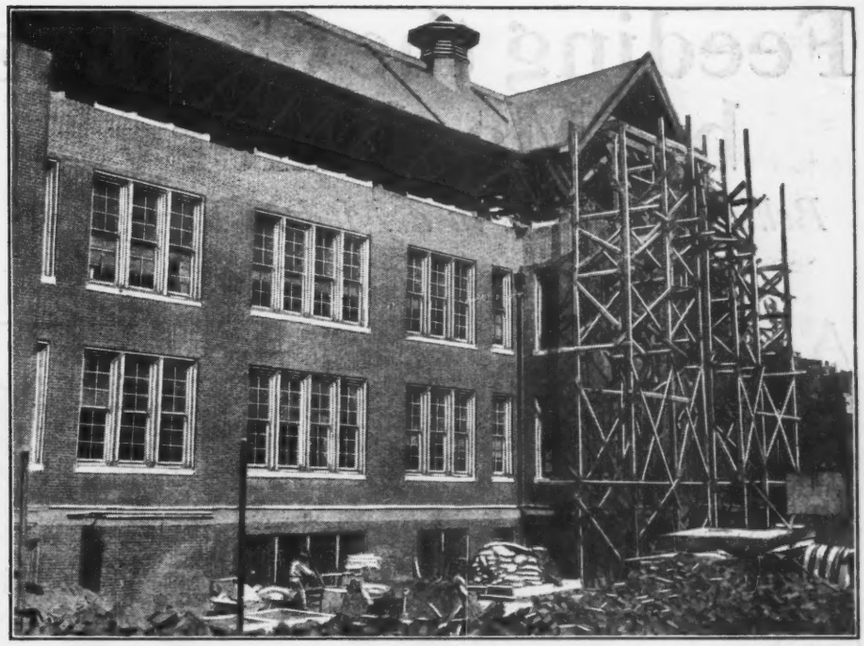
Shoe Shining Made Easier by Portable Cabinet

THE new portable shoe-shining cabinet shown below has an inclined corrugated rubber rest surface for the foot, a polish container that swings out to a handy position, a two-headed dauber brush and a double wool polisher with a reversible leatherette to protect the hands.

The cabinet is opened from the side by unlatching a simple catch. Four rubber feet on the bottom prevent scratching the floor.

One of the chief advantages of the outfit is its compactness. Nearly every person has used one of the old-time, clumsy shoe boxes that was about the size of a small chair and always in the way wherever it was placed. The new box, when not in use, can be put out of sight under a table or in a closet.

The outfit, showing compact cabinet



RAISE SCHOOL ROOF TO ADD A FLOOR

FOR centuries houses have been expanded by horizontal extensions. But now a schoolhouse in Washington, D. C., is being expanded upward. The entire roof, 150 feet by 75 feet, of the two-story Thompson grade school, has been jacked up 12 feet to permit the building of a third floor.

The plan is said to have proved most practicable and economical.

Electric Hammer Has Single Moving Part

AN ELECTRIC hammer with only one moving part has been designed for use by mechanics, builders, and manufacturers. The power tool will drill a one-inch hole three inches deep in concrete in one minute, it is claimed, and can be operated on slightly less current than would be required for an electric iron. Alternating current is necesary.

The hammer strikes 60 blows a second, while the operator pulls a trigger. The single moving part is a hardened steel hammer that moves back and forth within a bronze barrel.

At each end of the barrel is a coil of wire. These coils alternately become temporary magnets as the alternating current passes through them, driving and withdrawing the hammer.

New Rustless Mailboxes Made of Brass

TO RESIST the destructive, rust-producing effects of salt-tinged air, brass mailboxes are being introduced in a number of coast cities. Whereas such air is said to destroy the usual steel box within three years, the new brass receptacles are claimed to be immune to its action.

This resistant quality of brass makes it unnecessary to paint the new boxes the familiar green.

The photograph shows New York's first brass box, on Broadway near Wall Street, being initiated.

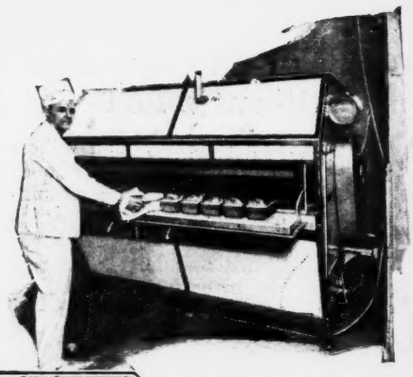
THE Editor will be glad to supply, wherever possible, the names and addresses of manufacturers of devices mentioned in this issue.

Using the electric hammer as a riveter

Feeding the Crowds by Machinery

Behind the Scenes in a Modern Restaurant

By Edward Woodward



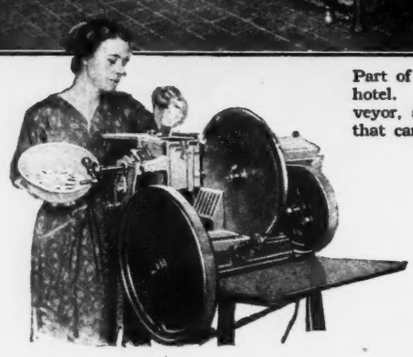
One of the newest types of automatic electric bake oven, in which bread baking is reduced to simple timing control

AS YOU have sat in one of our great modern restaurants or hotel dining-rooms during the crowded lunch hour, have you not marveled at the apparent ease and swiftness with which the wants of hungry hundreds are served—all at once? On every table, beside every place, are the inevitable bread and butter. Who bakes the hundreds of loaves? Who cuts the thousands of slices? Nearly every one has ordered potatoes. Who is the galley boy that peels them?

The answer is—machinery. Mechanical science has replaced hand labor in modern restaurant kitchens, just as it is replacing drudgery in the modern American home.

Consider the single item of bread in a restaurant that feeds, say, 400 persons at one time. You can imagine what an army of bread slicers would be required to serve such a crowd quickly. Yet a machine operated in large modern restaurants cuts 200 slices a minute—or a slice for every one of the 400 in two minutes! This electrical device takes loaves 24 inches long and cuts them with such nicety that all slices are of exactly the same thickness.

Part of the kitchen in a New York hotel. Note the power-driven conveyor, above the heads of the chefs, that carries raw foods to the ranges



At the left is shown a remarkable new machine that not only slices loaves of bread, but butters each slice in the same swift operation

Bread-Making Is Automatic

And while the bread is being sliced, another machine cuts dozens of little squares of butter at a single pressing. In fact, a remarkable apparatus recently invented for use where large numbers of sandwiches are required, not only slices the bread, but neatly butters each slice in the same operation!

In the most improved bread-making equipment the entire process is automatic from the time the dough is prepared in the kitchen. First, a divider and scale mechanism weighs and cuts the dough to the proper size. Another machine then rounds the dough and passes it on to a third apparatus, which kneads it until it is light and fluffy. A molder gives the dough its final shape, and it is ready for the ovens.

The latest automatic electric baking apparatus has an output of from 1600 to 3200 loaves an hour, yet requires only two attendants to operate it. Here the science of baking becomes simply a matter of timing. When one loaf is baked, all are baked, and all are uniform in quality. This is made possible by automatic temperature control.

Not so many years ago, breakfast—the regulation American morning meal of cereal, eggs, toast, and coffee—was one of the greatest problems of the restaurant owner. Today, machinery has made it one of the simplest. Toast, that formerly took a long time to prepare and required much individual attention, now is made at the rate of a dozen pieces at a time on an electric grill that automatically turns the pieces when they are brown, and toasts both sides evenly. Eggs, that must be boiled an exact number of minutes and half minutes, according to the individual taste of each patron, now can be cooked in a machine that dips them in boiling water, times them, and automatically takes them out of the water when their time is up.

Coffee can be made 40 gallons at a time—enough to supply 600 diners. Cream for the coffee is measured automatically by a machine that pours it into little individual pitchers, an ounce at a time.

At every meal, potatoes, like bread, are demanded in enormous quantities. An automatic machine peels three pecks of potatoes in three quarters of a minute. This apparatus is a great cylinder, the bottom of which is a revolving disk. The interior is lined with special concrete facing. As the potatoes are whirled around swiftly in the cylinder, they are knocked against the sides. The impact removes the skins in small flakes without bruising the potatoes. A small stream of water plays continually on the vegetables, washing away the residue. Carrots, turnips, onions, and other vegetables are prepared for the pot by the same type of machine.

For nearly every different way of serving potatoes there is a special machine. A motorized masher that operates like an egg-beater whips and mashes them at the rate of a peck a minute. Another machine slices the potatoes in uniform pieces for French frying.

Two Hundred Cakes a Minute

Cakes, pies, and other pastry that once tried the skill of every cook, can be turned out by the dozens at the press of a button. An automatic sponge-cake beater will beat 30 quarts of cake batter to feathery consistency. And when the electric oven has baked the batter to an even, appetizing brown, another machine drops the cakes out at the rate of 200 cakes a minute!

Pie crust is made by a motorized roller. And when the pie is in the dish, before it is put in the oven, a machine presses the rim of the crust down evenly and clips off the extra dough, while still another machine marks and crimps it.

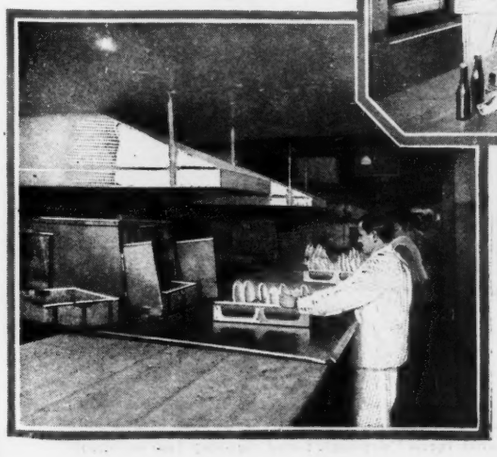
These are just a few of the marvels of scientific cookery as it is practised today. Others are shown on the opposite page.

Above is a typical view in a great modern restaurant during the lunch hour. To feed these hundreds of persons all at one time requires not only ingenious automatic machines that turn out food in large quantities, but also high-speed conveyor systems to carry food and dishes from the kitchens to the immense dining room

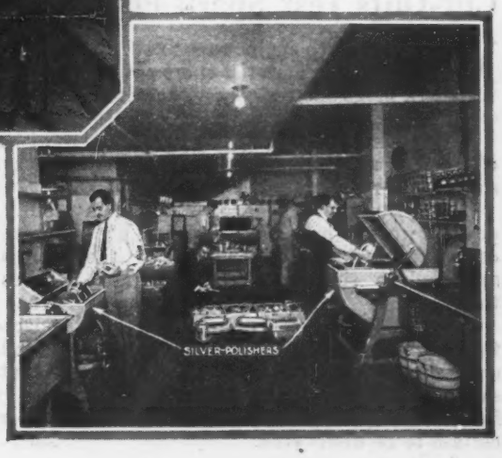
At the left is the soup kitchen of an up-to-date restaurant. The soup is cooked in a battery of enormous kettles, where the heat is controlled automatically, and is drawn off through spigots at the bottom of the kettles into serving buckets. These kettles hold enough soup to feed a thousand

Below is a new heavy-duty dish-washing machine, said to have a capacity of 12,000 pieces an hour. It does the work of an army of cleaners. The soiled dishes, in racks, are inserted in the machine. In a few seconds they are thoroughly scoured

Below: Silver-cleaning apparatus. The silver is cleaned by burnishing. It is immersed in a bath of small steel particles—highly polished balls and pins—that reach the otherwise inaccessible parts. These polish without wearing away the plate



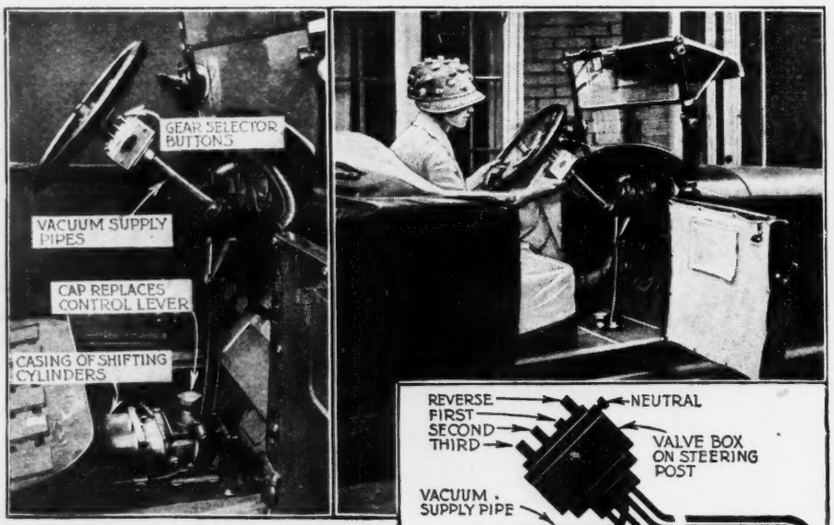
To save time and economize in space, elevators and other conveying apparatus are employed to carry food from kitchens to service- and dining-rooms on other floors. This kind of machinery has made it possible to prepare the food on several floors and to serve it in the dining-room without the slightest loss of time



ENGINE SUPPLIES VACUUM FOR AUTOMATIC GEARSHIFT

AN AUTOMATIC gearshift, operated by vacuum supplied by the engine and regulated by buttons at the rim of the steering gear, has been developed by a Pittsburgh manufacturer and recently offered to motorists.

Unlike electric shifts and other substitutes for the standard lever, this new method requires no additional power installation, beyond that already supplied by the motor. It is said to be quick, safe, and easy of operation, insuring proper meshing of gears under any condition of driving and permitting a selective shift.



Above: The driver's control mechanism of the vacuum gearshift, showing selector buttons for first, second, third, reverse, and neutral in a valve box close to the wheel. The layout of the entire vacuum system is shown in the diagram

A pipe connected with the intake manifold supplies the vacuum by which the shifts are made. This pipe is connected with a series of cylinders, corresponding to first, second, third, and reverse gears. To shift gears, the operator presses one of a set of buttons at the steering wheel, corresponding to the gear desired. This button operates a valve that causes the motor to withdraw the air from the cylinder that controls the movements of the gear. When the clutch pedal is pushed to the floor and released, the gear mechanism is unlocked and the desired shift made.

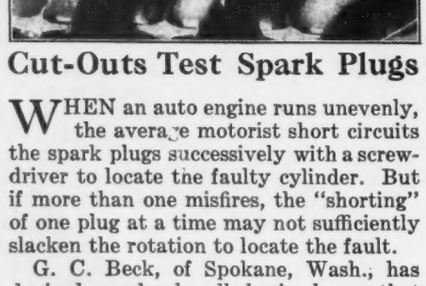
By the vacuum control system it is possible to prepare for anticipated shifts in advance. Then movement of the clutch pedal will make the necessary shift without the need of removing the hands from the wheel, which means additional safety.

When the motor is idling, sufficient power is generated, it is said, to permit the shift to be made from neutral to first speed with surety, even on cold days when the lubricant in the transmission case is stiff and sluggish. By partly engaging the clutch after one shift has been prepared, and then setting the button for the next shift, it is possible to engage the clutch and then pass at once to the next speed by pressing the pedal and engaging again. This is said to furnish much faster and more certain control of speed and a quicker "pick-up."

Stripping the gears by forcing them to engage at improper speeds is said to be impossible with vacuum control, since the operation is performed automatically. The valve box contains five buttons for three forward speeds and reverse and neutral. It is impossible to shift to reverse accidentally, since the neutral button must be used first before it is possible to put the car in reverse.

The apparatus, it is said, can be installed in a few hours by an experienced mechanic on any car having selective transmission. It requires no alteration of the instrument board, steering post, or floor controls. A one-inch hole in the flooring to permit the entrance of the pipe from the valve box is the only alteration necessary. The gear lever is of course removed, and in its place is installed a polished cap that may be removed to lubricate the transmission.

The manufacturers assert the vacuum gear control costs nothing to operate, since the power required to operate it is present in the automobile engine.



Cut-Outs Test Spark Plugs

WHEN an auto engine runs unevenly, the average motorist short circuits the spark plugs successively with a screwdriver to locate the faulty cylinder. But if more than one misfires, the "shorting" of one plug at a time may not sufficiently slacken the rotation to locate the fault.

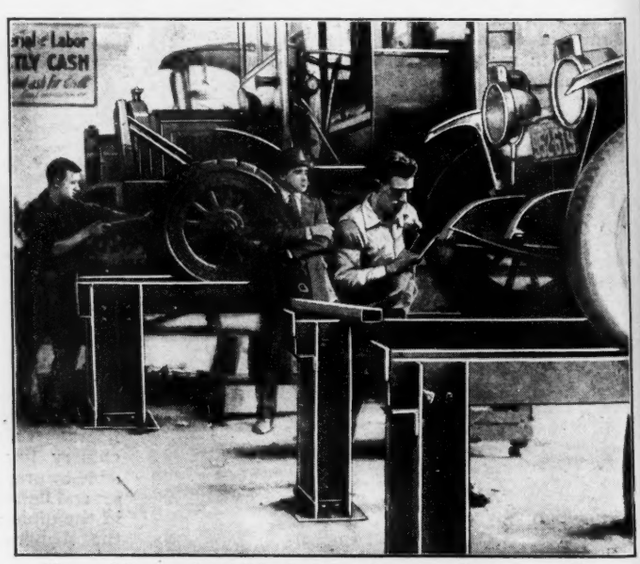
G. C. Beck, of Spokane, Wash., has devised wooden-handled wire levers that can be attached permanently to the spark plugs situated beneath the ignition wires.

When all but one of the levers are moved to bring the ends in contact with the iron shells, but one cylinder can fire. Mr. Beck says that if all cylinders are thus tested independently, the dead cylinders are certain to be discovered.

AUTO DRYDOCK SPEEDS REPAIR WORK

TO ACCOMPLISH greater speed in automobile repair work, as well as greater convenience for mechanics and motorists alike, a garage owner in Boston, Mass., has equipped his shop with an ingenious automobile drydock built of steel channel beams. This innovation makes it possible for mechanics to make repairs—such as mending broken springs — beneath the body of the car without the use of jacks.

The drydock is built of channel beams riveted and bolted to form a series of runways. The beams are spaced so that automobiles in need of repair enter the "drydock" from the street level, and run along the elevated tracks. In the repair shop they are elevated about three feet.

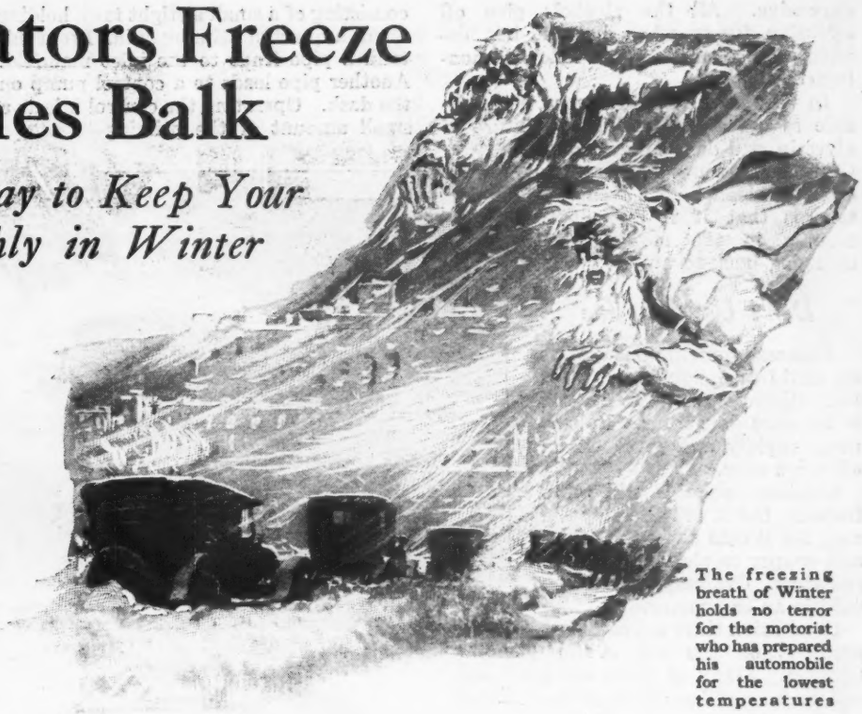


Channel beams form "drydock" and runway for automobiles

When Radiators Freeze and Engines Balk

There's a Sure-Fire Way to Keep Your Car Running Smoothly in Winter

By F. A. Platte
Instructor, Department of Physics, Columbia University



The freezing breath of Winter holds no terror for the motorist who has prepared his automobile for the lowest temperatures

WINTER—frozen radiators and balky engines. Nearly every motorist thinks of them together. But why should the pleasure of automobile driving vanish with the migrating birds? Is there no sure-fire preventive for the frozen radiator and the cracked water jacket? Can't we count always on hearing the purr of the engine after a single push on the self-starter?

For every car there is an effective way to avoid the most common of wintertime woes. First, let us consider the cooling system and its troubles. All freezing can be avoided if a proper mixture is maintained in the radiator and its connections. There are many varieties of anti-freezing mixtures that can be bought or made. Some are effective, others injurious; but it is safe to say that denatured alcohol mixed with water is the most successful for general purposes.

Find Lowest Winter Temperature

Denatured alcohol will not freeze until the temperature falls to 200 degrees below zero. A mixture of water and alcohol will freeze at a temperature correspondingly higher, depending on the amount of water used. Find out how low the thermometer usually falls where you live; then consult the following table to determine what ratio of alcohol to water you should use:

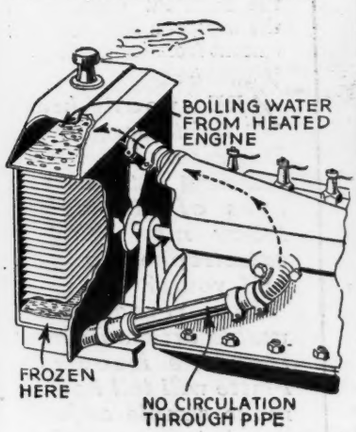
Temperature	Alcohol	Water	Specific Gravity
18° F.	1 part	5 2/3 parts	.9820
12°	1	3 1/2	.9740
0°	1	2 1/3	.9625
9° below	1	2	.9578
20° below	1	1 1/2	.9475

Before filling, inspect the radiator and joints for leaks. Repair these and find out how much liquid the system will hold. Fill up the radiator with water, then drain it off through the petcock at the bottom. Measure the drained water with a quart measure and remember the quantity as the figure to be used as long as you operate the car. The average content of radiator and water jacket is 35 quarts. This would require 15 quarts of alcohol in a locality where the lowest temperature is zero.

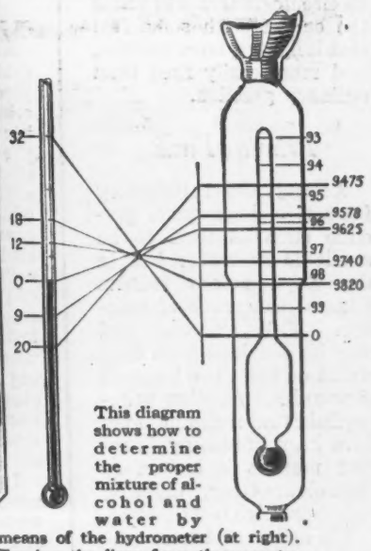
Now close the petcock, pour denatured alcohol into the radiator and fill it up with water. Of course the mixture will not last indefinitely. The radiator should be inspected and filled every day just as in the summer. Some motorists mix water and alcohol in the original proportions and continue to fill with that mixture. This is wrong, for it will cause the radiator to contain nearly all water in a short time. This is due to the fact that alcohol boils away at a lower temperature than water, namely 171 degrees. If you find that you require the addition of a quart of liquid, it may be that most of the replacement must be alcohol.

A sure method of making additions correctly is to rely only on a hydrometer, an instrument that determines the specific gravity of liquids lighter than water. When inserted in the mixture of the radiator it will tell exactly the proportions of water and alcohol. In making readings, the temperature of the mixture should be about 60 degrees; otherwise the hydrometer will not register correctly. A method often satisfactorily employed is to make replacements with a mixture containing 75 per cent alcohol. In general, this will keep the alcohol content high enough.

Wood alcohol should not be used. It is harmful to the rubber and metal connections and its fumes injure the eyes. Grain alcohol is effective but too



"I wonder what can be the trouble?" asked the puzzled winter driver, as his engine balks and he sees steam coming from his radiator. Without warning, the water passing through the cooling coils of the radiator has frozen at the bottom, cutting off circulation in the cooling system. Meanwhile the heat from the engine boils the impounded water at the top of the radiator, as shown in the diagram



This diagram shows how to determine the proper mixture of alcohol and water by means of the hydrometer (at right). Tracing the lines from thermometer readings (at left) gives the correct hydrometer readings in specific gravity

expensive. All the alcohols give off offensive fumes when heated, but denatured alcohol fumes are mild and non-injurious.

In very cold climates it may be advisable to use a half and half mixture of glycerin and denatured alcohol. Glycerin does not evaporate so easily as alcohol. Its disadvantage is that it is difficult to remove in the spring when changing back to water.

Don't Use Kerosene

Kerosene sometimes is used as an anti-freeze liquid, but it is not satisfactory. When heated, it becomes dangerous. It boils away rapidly and gives off an offensive odor.

Calcium chlorid will stop freezing, but it will also stop the car; for it eats away the solder and copper or aluminum in the radiators. Ordinary salt can be used in an emergency.

In addition there are patented products on the market for stopping freezing. Many of these are good and will work as well as the denatured alcohol mixture recommended. Radiator covers will help also, by protecting the liquid from wintry blasts.

If your radiator has been taken care of according to the directions given, the next consideration should be that of quick starting. Too often, when you turn on the ignition and step on the self starter, the engine fails to budge. What is wrong? The trouble usually is that cold gasoline vapor from the carbureter strikes the cold walls of the cylinders, condenses, and forms puddles on top of the piston. This liquid cannot explode. No matter how often you shoot a spark through the plug, your engine will remain dead.

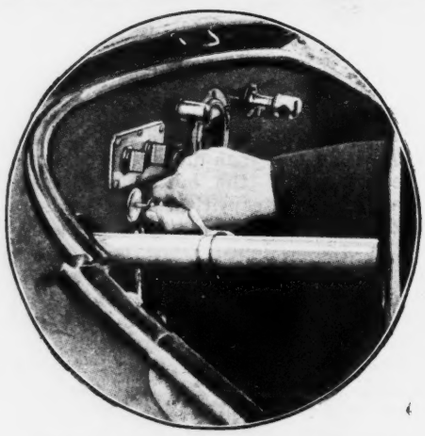
The easiest way to avoid this difficulty, of course, is to keep the car warm in a heated garage. But you cannot take the garage along when you go downtown and park your car at the curb. Undoubtedly the simplest way to assure quick starting under all circumstances is to prime the engine with some fuel that is lighter, more volatile, and more easily fired than ordinary gasoline.

Priming Fuels

Among the satisfactory fuels is a high grade gasoline such as used to be available as motor fuel in the days before refiners lowered the grade of gasoline. This high-test fuel may be obtained from drug stores or from the large oil companies. Another priming fluid that manufacturers have been producing in recent months is known as "petroleum ether," differing little from high test gasoline.

The easiest and most convenient method of priming is to install an equipment consisting of a small airtight tank holding about a quart of priming fluid. From this tank a pipe leads to the inlet manifold. Another pipe leads to a control pump on the dash. Operating the control injects a small amount of the priming fuel into the inlet manifold. From there it is sucked into the combustion chambers, firing at the first spark.

A few drops of petroleum ether, injected into the petcock of each cylinder with a priming gun, is an effective means of starting



A primer with dash control provides an easy means of quick starting on a cold day

Another method is to keep a small bottle of petroleum ether and a priming gun in your toolkit. When the engine refuses to respond, shoot a few drops into each cylinder through the petcocks near the spark plugs, or into the float chamber of the carbureter. You will be surprised at the effect. In temperate climates a mixture of half ether and half benzine will be found to work well.

Ether Aids Starting

Some motorists add three ounces of ether to every five gallons of gasoline in the tank. This will aid in obtaining proper vaporization for starting. To aid further in vaporization it is well to open the throttle when turning off the ignition in stopping the car. In this way the vapors will be drawn into the cylinders without burning, remaining there until you are ready to start again. Also cover up the hood of the car when you put it into the garage in the evening. Enough heat will be retained in the engine to prevent the cylinders and carbureter from becoming too cold.

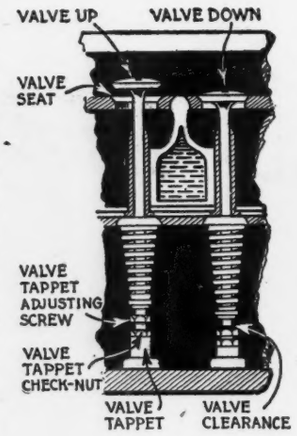
In spite of all of these precautions, trouble occasionally is encountered in starting, by reason of the fact that gasoline will not pass through the carbureter. This usually is because a drop of water has frozen over the opening leading into the bowl of the carbureter. Even though the gasoline used may have contained no water, the cold bowl of the carbureter may condense enough water vapor from the air within to cause a drop to accumulate. Make an inspection for this trouble before you decide to tear the engine apart.

Since warm gasoline will assist greatly in starting, many means have been resorted to in order to heat the carbureter. Electric heaters, reflectors or even electric irons have been used successfully to accomplish this result.

Electric heaters are available on the market to keep the carbureter and the manifold warm while the engine is idle, utilizing current from the battery.

Know Your Car

YOUR Cylinder Valves—There are two valves for every cylinder; one to admit the explosive mixture and the other to release the burned gases. Opening and closing are regulated by the action of cams attached to a shaft that conforms in its turning with that of the main shaft, with which it is connected through gears. As the cam turns, it raises and lowers a small piston called a "tappet." The vertical motion of this tappet is transferred to the stem of the valve, causing the latter to be raised from its seat when it should be open and lowering it when the port should be closed. A spring surrounding the stem serves to keep the valve stem pressed against the tappet during this movement.



In order that the valve may seat properly, the tappet must be separated from the stem when in its lowest position. The amount of this air gap varies in different cars from the thickness of tissue paper to one sixteenth inch.

ARE your headlights dangerous? Do you realize that a blinding glare in the eyes of the other fellow may bring a catastrophe to you and yours?

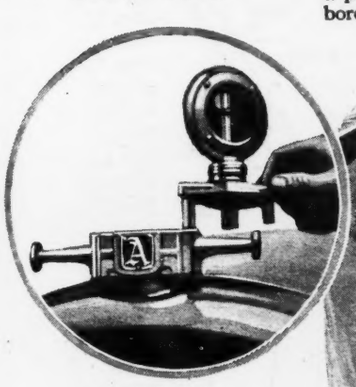
In a remarkably usable article in next month's issue Mr. Platte will tell how to make simple adjustments to assure safety to yourself and others in night driving.

New Inventions for Auto Comfort

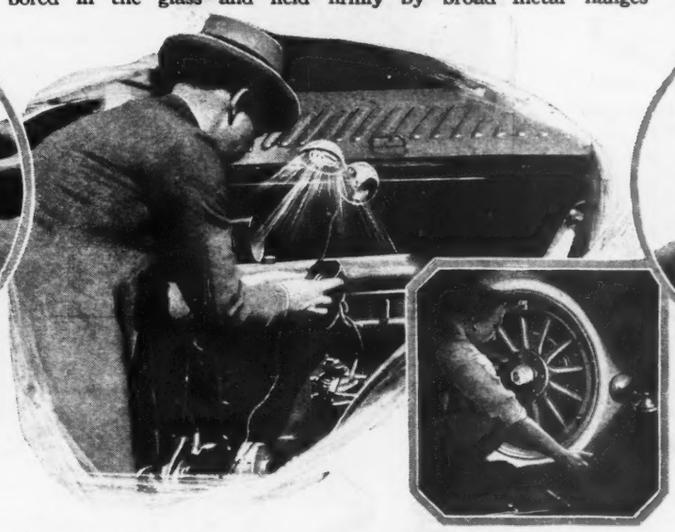
Equipped with a control lever within easy reach of the driver's fingers, this auto light dimmer has the advantage that its mechanical parts are inclosed in a steel housing. Installation requires no hole boring nor rearrangement of the lighting system

Operating the spotlight from within a closed car is possible with a new lamp inserted in the windshield and controlled by the driver by a pistol grip and trigger switch. The device is inserted in a hole bored in the glass and held firmly by broad metal flanges

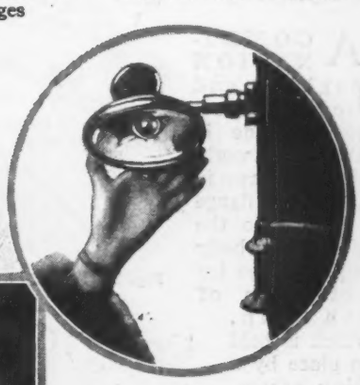
Three numbered dial rings below the steering wheel spider control this new combination safety lock. Setting the combination with the rings locks and unlocks the steering post when a small lever is lifted



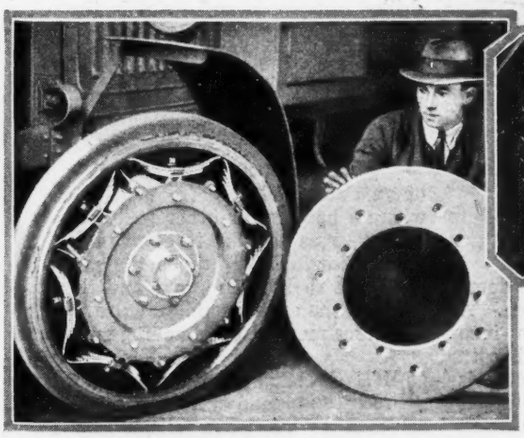
A radiator cap that swings aside when the radiator is to be filled is said to be theftproof and to prevent jarring of the motometer. Turning a knob on one of the wings permits the cap to slide up and swing to the side



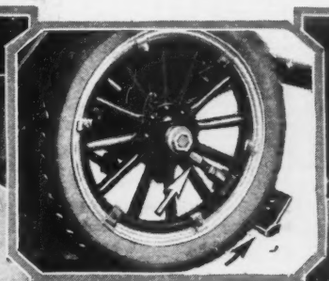
This folding automobile lamp can be placed in any position on the car where illumination is needed, and is attached by means of a ring and a U-shaped spring clamp at the base



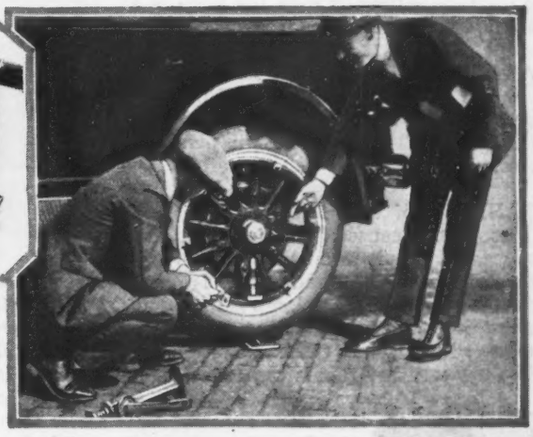
A combination rear view mirror and parking light is an unusually useful auto attachment. Turning the mirror to face downward automatically switches on the light attached to back of mirror. The switch is concealed in the bracket arm



Resiliency of pneumatic tires is claimed for this spring wheel designed for heavy, solid-tired trucks. Short leaf springs radiate from the hub



Crawling under the car is said to be unnecessary in operating the jack shown above and at the right. Turning a thumbscrew attaches the jack to wheel rim and hub



The jack in operation. Its broad base is brought to rest on the ground simply by driving the car slowly forward or backward

Handy Kinks for the Auto Owner

WHENEVER spark plugs are carried loosely under the seat or in the toolchest, it is often found that the porcelains have been cracked. A safer and more convenient method is to carry the spare plugs on a rack fastened to the dash under the hood (Fig. 1). A wooden strip, bored with holes to receive the threaded ends of the spark plugs, is fastened with wood screws under a bent strip of sheet steel, which has slots to receive the contact screws of the plugs.

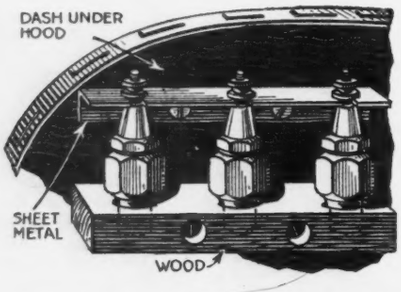


Fig. 1. Holder for spark plugs under hood

A COMBINATION parking and trouble light, easily made in the home workshop, is shown in Fig. 2. A flange attached to the side of the body supports the tee extension of the lamp, which is held in place by a wing screw. The 1½-in. opening through the flange allows a 20-ft. length of lampcord to be passed in underneath the seat without lifting the cushion. A switch may be installed integrally with the lamp or a separate switch may be placed on the dash.

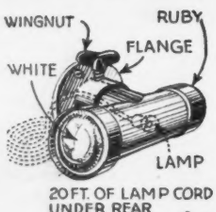


Fig. 2. Trouble light

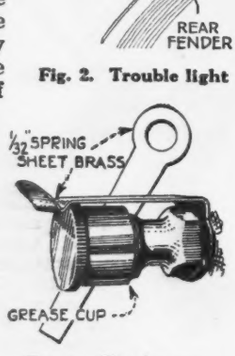


Fig. 3. Clip for cup

A SPRING clip fastened to the grease cup as shown in Fig. 3, will prevent the cap from becoming unscrewed and falling off. The clip is held in place by the stem of the cup.

FAILURE of a tail lamp to light is sometimes caused by a short circuit in the ground circuit when the frame of the car is used as the ground. This is more apt to happen when the lamp is mounted on the tire carrier. Running a wire from the lamp bolt back to the frame of the car will show whether this is the trouble.

THE ignition locks on automobiles seldom are designed to make the car completely thiefproof. Knowing the construction of the various types of ignition locks, criminal mechanics readily find means to wire around them and start the car without the aid of a key.

However, by inserting a secret breaker in the circuit, as shown in Fig. 4, it is an easy matter to outwit the thieves. One of the wires from the battery is led to a screw in the jamb of one of the doors before passing to the general system. A second screw is situated about an inch from the first one and is connected with the wire leading out. A small notch is made in the wood slightly above the upper screw to hold the hooked end of a small metal plate. Closing the door holds the plate firmly against the heads of the two screws and the circuit is closed. When the car is parked, it is necessary only to take out this plate to break the circuit.

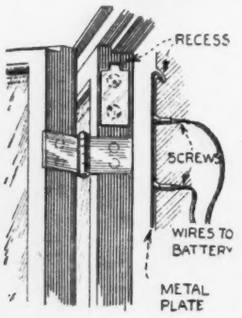


Fig. 4. Theft switch

Fig. 5. When stuck in a mud hole, a machine can be raised to solid ground by fastening a short length of wood or heavy pipe to the rear wheels

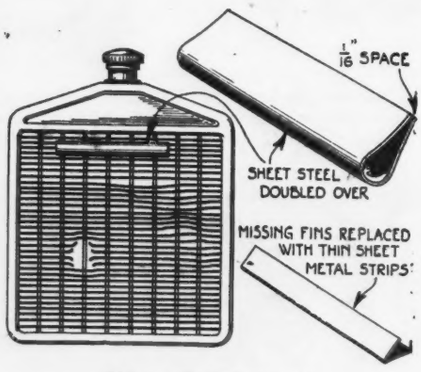


Fig. 6. Straightening and repairing radiator fins

IF THE fins of a tubular radiator are badly bent, they can easily be made even and straight by using the tool shown in Fig. 6. This is a sheet of steel plate, doubled over at the center so as to leave the edges about 1/16 in. apart. The tool should be about 12 in. long. When fins have been broken out, they can be replaced by thin sheets of brass soldered in place and straightened. After all the fins have been alined, the radiator can be given almost the appearance of a new one by painting it with a coat of black paint diluted with turpentine.

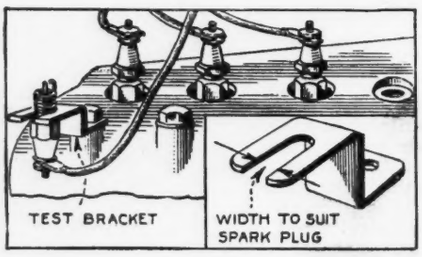


Fig. 7. Bracket useful for testing spark plugs

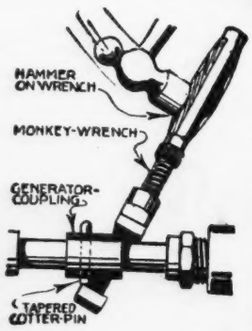


Fig. 8. Removing pins

FOR testing spark plugs rapidly and without danger of being shocked the holder shown in Fig. 7 has been found satisfactory. It is simply a piece of steel or brass with a hole drilled in one end and a slot in the other end large enough to fit the plug thread. The bracket is held under a cylinder head bolt in such a position that all leads will readily reach a plug held in it.

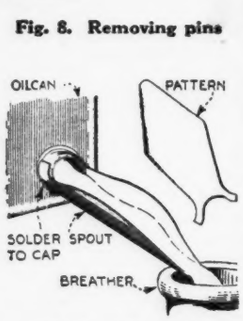
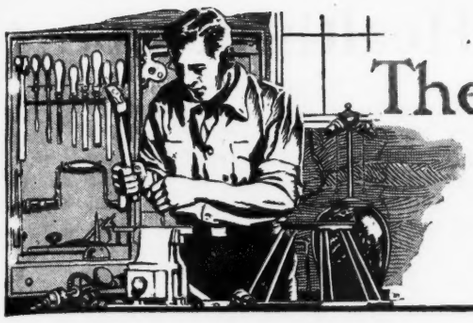


Fig. 9. Oil spout

TAPERED cotter-pins in pump-shafts, generator couplings, and in the engine of an automobile are frequently located where a hammer or other tool cannot be placed so as to permit of driving them from below. Many times the mechanic will drive them from above and they will fall into the engine pan. Figure 8 shows a quicker method of removing such pins.

THE detachable oil spout shown in Fig. 9 is made of a small piece of tin soldered to an extra oilcan cap from which the top has been cut. The spout is used for pouring oil without waste into the breather tube of an auto.



The Home Workshop

Arthur Wakeling, Editor

Sewing Cabinets Home Craftsmen Can Build

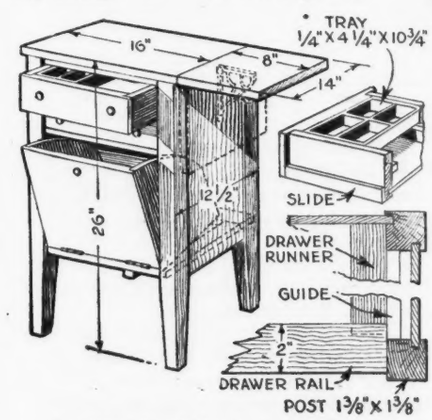
THIS especially dainty and attractive Priscilla sewing cabinet, which costs little for materials and requires no elaborate joinery, is an ideal piece of furniture for construction in the home workshop.

If you have a place in your home for such a cabinet—and in most homes a corner of the living-room, if not a special room is set aside for sewing—it will well repay you to build one. Don't let the turned posts and stretcher deter you, because if you have no access to a lathe, you can have them turned quite reasonably at any carpenter shop where there is a lathe, or at one of the small woodturning shops to be found in all cities and many towns.

Many requests have been received from readers for a magazine article or a blueprint on a Priscilla or, as it is sometimes called, a Betsy Ross sewing cabinet; and the general interest among home workers in this type of project is indicated by the fact that the now famous Home Workshop Blueprint No. 1, a sewing table, issued exactly two years ago, is still in great demand and hundreds of copies are being sold.

It is true that Priscilla cabinets can be purchased for small sums in department and furniture stores, but there is no comparison between the average cheap commercial cabinet and one made by hand from genuine selected walnut or mahogany along lines as structurally and artistically sound as this cabinet. Commercial cabinets, unless of the best quality, will deteriorate with age; this cabinet, if built and finished properly, will actually improve and gain with passing years the richness and beauty of surface that distinguish fine heirlooms and antiques.

As an additional aid for those who wish to build the cabinet, a blueprint (No. 31 in the Home Workshop series) with full size details has been prepared and can be obtained for the nominal charge of 25 cents to cover the cost of blueprinting, handling, and mailing.

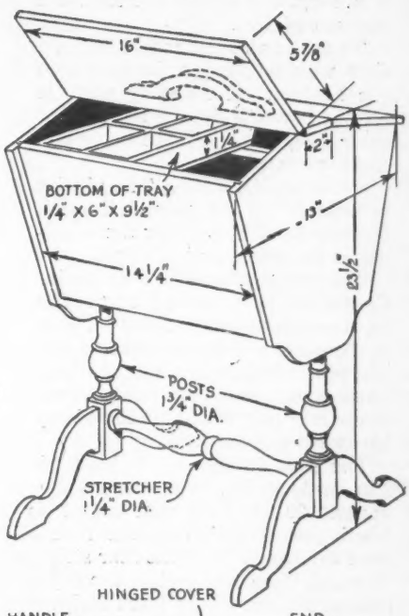


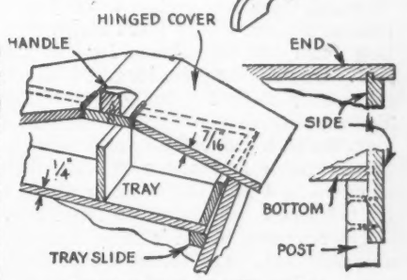
An alternative design for a modern sewing cabinet, which does not require any turnings

This useful and beautiful Priscilla cabinet in genuine mahogany or walnut will grace any sewing room

So little material is required that it will pay to use walnut or mahogany. The case itself requires stock about 7/16 in. thick. A board or two should be obtained sufficient to cut the two sides 10 by 14¾ in., the two ends, 11½ by 13 in., the two lids 5⅞ by 16 in., and a strip for the top center 2 by 16 in. The posts or standards require 2 pieces 1¾ by 1¾ by 10½ in., either solid or glued up from ⅞-in. stock, and the stretcher requires a piece 1¼ by 1¼ by 14 in. Each pair of feet is cut from one piece of ⅞-in. stock 4 by 8 in., and the handle requires a piece ⅞ by 1¾ by 10½ in.

The rest of the stock need be only ¼ in. thick. The bottom of the case is 6 by





Construction of Priscilla sewing box with main dimensions and details of the important joints

14¾ in.; the bottom of the tray, 6 by 9½ in. The sides of the tray are 1¼ by 10¾ in.; the ends of the tray, 1¼ by 5½ in. The long division in the tray is 1¼ by 9⅞ in.; the center division 1¼ by 5½ in., and the tray rests or slides are ½ by 14¼ in. To reinforce the bottom, 2 pieces ⅜ by ⅜ by 14¼ in. are fastened underneath the long edges.

Besides these parts of wood, four brass 1 by 1 in. hinges, as well as nails, screws, dowels, and glue are required.

Note the tongue-and-groove construction of the case joints, between both the sides and the ends and between the ends and the bottom. The stretcher is tenoned into the posts, and the feet are attached to them with dowels.

If for any reason turnings cannot be obtained easily, the modern sewing cabinet illustrated in the left-hand column is an excellent alternative design. The essential dimensions and details are

(*Continued on page 122*)

Unique Ski Sleds Provide Healthful Sport

By Roland B. Cutler

WHEN you're pilot of this chummy tandem scooter (Fig. 1) and the other rider swings up behind after pushing off, you can be sure of a speedy joy ride, right side up.

If good staves are not available, ski material must be steamed (see Howard Greene's article on skis in last December's POPULAR SCIENCE MONTHLY) and, when partly cooled, wired to posts, as shown. The front post is shaped from a 38-in. length of 2 by 3 in. stock, 31 in. of which is rounded off to 2-in. diameter. Cut the rear post 9 in. long, and square one end for a distance of 2 in.

To each post, center and fasten a shoe with finishing nails sunk into the bottom. A mending plate is riveted beneath the toe and heel of each shoe, the end holes being left free for the wire.

For stringing a shoe, 7 ft. of wire is needed. It is passed through screweyes set 1 in. below the shoulder of the posts, as indicated.

The runningboard is 5 by 38 in. Center one post hole 3 in. from the front end and make a slot 4 in. long in the other end for suspending the rear post. Before inserting the long screw pivots, round off the shoulders of the rear post so that it can swing backward and forward.

The seat framework is built of 2-in. wide strips. Cut the middle upright 22 in. long and center to the runningboard with a corner iron 17 in. from the front. Cut the rear strip 25 in. long and hinge one end to the top of the post as shown. Two more strips 24 in. long form the foundation for the front seat. One can be 2 in. longer, if desired, to make a rung for supporting a horn. The seat board is 7 in. wide and 20 in. long, the seat proper being approximately 7 in. square and the remainder being trimmed to 4 in. wide. Center a hole for the front post 2 in. from the front end.

The rear seat board is 23 in. long, with a square seat. The forward part is 5 in. wide. It is fastened to the upright 16 in. above the runningboard with a long screw at each side. The hand grip is a 12-in. length of broomstick secured in holes centered 1½ in. from the ends of the strips supporting the front seat.

For steering aids, split a 2 by 3 in. piece into two 12-in. lengths, 1½ in. wide. For the foot-piece bend 1½ in. of the ends of a 6-in. strap-hinge clip as shown, and insert a wedge between the parts, securing it with a nail through each middle screw hole.

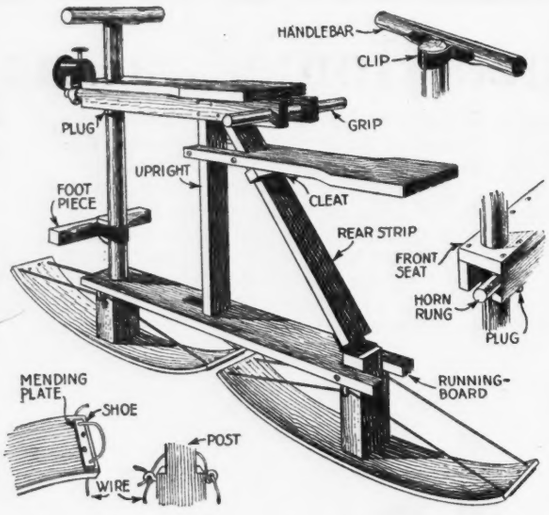


Fig. 1. The tandem scooter completely assembled and some of the details. Note how the rear shoe is pivoted to runningboard

The handle-bar is 14 in. long, clipped at the top of the post with a 4-in. strap hinge. Under the end of the front seat construction, 4⅜-in. hardwood plugs or dowels key the post to the frame. Bore the holes for them at quarter points around the post and allow the plugs to extend 1 in. to support the three seat members.

The list of materials for the scooter is as follows:

2 wide barrel staves, or ski material of similar size
6 ft. of 2 by 3 in. studding
1 light strap hinge, 4 in.
1 light strap hinge, 6 in.
1 corner iron, 4 in.
1 hinge butt, 2 in.
4 mending plates, 4 in.
1 board ⅞ by 7 in. by 10 ft.
4 screweyes, 1½ in.
1 doz. screws, No. 12, 2¼ in.
2 doz. screws, No. 7, 1 in.
8 rivets, No. 9
14 ft. soft galvanized wire, No. 12

The light, springy coaster (Fig. 2) is geared up to ski speed and will shift into "high" at one push of a toe accelerator. Although only 5 ft. long, it will not limp under any overload, for it's built for business as well as speed.

The hardwood stock required is as follows:

2 shoes, each ¾ by 3 by 66 in.
2 ledge pieces ¾ by 3 by 66 in.
One 16-ft. length of flooring, ⅜ by 3 in.
2 beams, each 1 by 4 by 15 in.
4 posts, each 1 by 2½ by 7 in.

The hardware necessary is:

4 light strap hinges, 5 in.
8 light T-hinges, 3 in.
16 stove bolts, 3/16 in. by 1 in.
5 doz. screws, No. 6, 1 in.
26 ft. galvanized wire, No. 12
4 corner braces, 4 in.
8 mending plates, 3 in.
½ doz. screweyes, 1½ in.
1 doz. screws, No. 8, 1½ in.

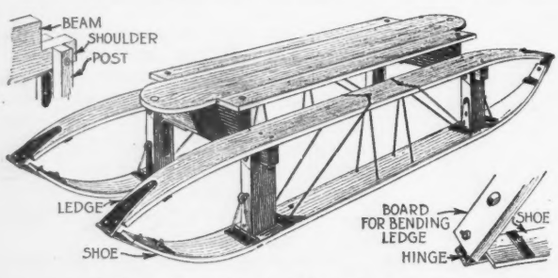


Fig. 2. The ski coaster, which is built easily and cheaply because the double-end runners can be sprung into shape without steaming

Shoulder each end of the beam 1½ by 3 in. long and fit the shoulders into 1½-in. deep mortises in the posts. Fasten posts and beams together with screws at each side, as shown in the left-hand detail. Under each beam place two 4-in. corner braces. To the lower end of each post attach the flap of two 3-in. T-hinges. Note the screweye inserted through one hinge for wiring.

Nail the ledge pieces over the shoulders, centering each post 15 in. from an end. Set this frame on the shoes and locate the end holes in the hinges for wiring. These wire holes are centered in the shoe about 2 in. apart. Midway between the posts, make two pair of holes 6 in. apart, and in the ledge, center one wire-hole above each pair.

Loop 13 ft. of wire, with equal ends, through a screweye at one end and then wire as shown, keeping the ledge and shoe parallel. Tap all bends in the wire to fit snugly, and cut into the edge of the ledge for the wire to pass. Secure this wiring in the opposite screweye.

A 5-in. strap hinge connects the end of each ledge and shoe. A stove bolt is passed through the end hole of each strap, and a 3-in. mending plate is used in place of a washer on the inside. Trim the shoes to about ¼ in. thickness and bolt the hinges only to them.

To bend and to hinge the ledge, use a thick piece of board, as shown at the right. Notice the large hole in which the end of the hinge flap must rest, flush with the under side. Bolt the end of the ledge to one of the hinge screw holes. With this "squeezer" drawn over the ledge, the end hole of the flap can be located, and the fastening made as to the shoe. The middle seat boards are 50 in. long, and the side boards are 40 in. long.

Special Line Holder Aids in Fishing through the Ice

If an old chair cannot be found, this holder can be made easily from other material

THOSE who have tried the ordinary and not entirely satisfactory ways of holding the line in ice fishing, will find useful the line holder illustrated.

To make one like it, hunt up a discarded chair and cut off a length of one of the turned legs, as shown, leaving parts of two spindles connected with it.

A sharp point for the holder is provided by inserting a nail, about 2½ in. of which is allowed to protrude. File the head end to a sharp point and provide a ferrule, if possible.

When ice fishing, let down your line to the right depth and jab the spike into the ice. When your bobber begins to dip, signaling a bite below, the holder can be instantly seized.—ROBERT PAGE LINCOLN.

Saving Money in Building a Small House

By R. J. Stephens

IN building a home, few of us plan far enough ahead. We find later that we should have had a breakfast room, more attic space, or something equally expensive or perhaps impossible to add.

If you are short of funds when you build or buy your home—and who is not?—plan so that you can add to the house without detracting from its graceful lines and without giving the additions the appearance of an afterthought. If you are thinking of building this spring, start at once to make as complete plans as possible.

It would be folly to suggest one ideal type of a small house; yet, countless as are the excellent plans furnished by various agencies in the building industry, many prospective home builders are unable to decide on just what they want, or, having decided, eventually find a lot of changes they would like to have made.

As regards the small house, it goes without saying that the two-story type is the most economical. It doubles the floor space on the same foundation and under the same roof.

It is better to have fewer rooms and at least one large living-room in which to "live" and receive your guests than to cut up a house into little rooms or cells, as indicated by the two typical plans below. A large living-room can be a combination living-room, dining-room, and even bedroom.

Every time you add a partition, you have added four corners to your floor space, which are good for nothing except to set a piece of furniture in; at the same time you have cut off air and light, added further expense, and in some instances made the house more difficult to heat uniformly.

Cheap as is a concrete foundation, it can be made cheaper by a little common sense in building it. Concrete work is hard and yet I have seen many men mixing their material far away from their forms, hauling the extra weight of water, slopping it all over, losing lots of it, and handling it twice instead of once. Build the mixing board, if possible, so that it is lipped over the edge of the forms (Fig. 5). This practically cuts the labor of mixing and pouring in half.

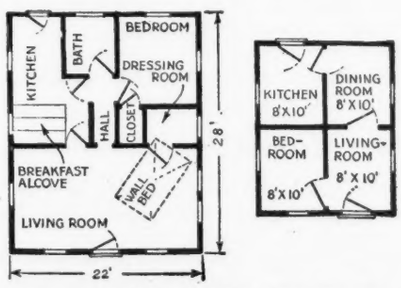
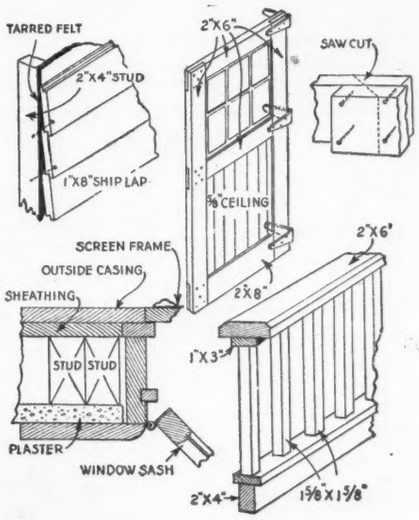


Fig. 4. Typical bungalow plans, the one at the left having all the advantages

The illustration shows the method used where there is a high exposed wall and where wheelbarrow trestlework would otherwise have to be built around the forms. On a level lot the idea works even to better advantage. The idea is not to haul the mixture after mixing, but to arrange so that the concrete can roll right off the mixing board into the forms practically by gravity.

For foundation work, I have found it sufficient to turn the dry mixture only once and then to apply plenty of water.



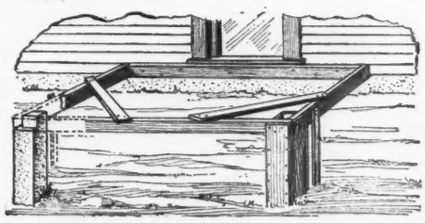


Fig. 2. Above: Five building suggestions that are simpler than the standard construction. Fig. 3. At left: An unusually easy way of making porch piers and frame

In Fig. 3 is shown an easy method of constructing porch foundations and framework without wasting any time making unnecessary calculations. Cut the four outside joists according to the length and width of the porch and nail them all square and level with the aid of two temporary 2 by 4 in. supports. Nail braces across the corners to hold the frame square and then construct the forms for the piers from 8, 10, or 12 in. boards at the outside corners. A few nails set at random inside the joists at the corners will help strengthen the work when the concrete is poured. You will see, also, that the joists rest on square shoulders of the piers, which is excellent construction. A small house that is to be set on a foundation of piers can be laid out in the same way.

Wide drop siding, which is quite popular in many parts of the country, can be imitated at a considerable saving, as shown in Fig. 2, by using ordinary shiplap, one of the cheapest varieties of lumber. Being much heavier than regular drop siding or clapboards, it can be applied over good tarred felt directly to the studs and does away with the necessity for using sheathing, when the building code allows. This is a substantial saving in both time and material and yet makes a house warm enough for any moderate climate. In such construction it is, of course, necessary to set the door and window frames before applying the siding. The casings should be shimmed out with lath so that the ends of the siding will not project beyond them.

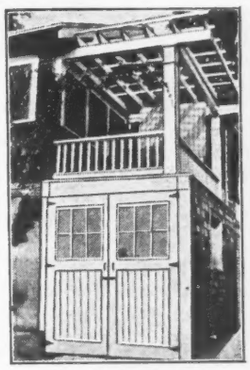


Fig. 1. The porch and garage addition

The simple construction of garage doors shown in Fig. 2 involves making only simple saw cuts. If the joints are close and put together with screws, such a door will need no braces to prevent its sagging. The sash used in this door is the regular 32 by 32 in. sash salvaged from government cantonments and usually obtainable at second-hand lumber companies for about $1.25 each.

Note also the use of common barn door hinges, which can be purchased for about 10 or 15 cents each. If hinges are selected that will open back to 90 degrees, one leaf can be placed on the inside of the door jamb, thereby making the hinge look like a regular garage door hinge. This type of door is illustrated in Fig. 1.

In an article published in the January, 1923, POPULAR SCIENCE MONTHLY about my home, I showed a proposed extension of a porch and this photograph indicates how the extension was finally completed with a garage below. By opening a basement window, the garage can be heated sufficiently in winter. The porch above the garage is finished in pergola effect, which makes it cooler in summer and does not shut out the sunshine in the winter from the triple window that opens on it. The ease with which this addition was made was due purely to foresight in planning.

An easy method for building porch and stair railings is shown in Fig. 2. Practically no nails are exposed and there are no places to catch and hold the moisture. The 1 by 3 in. strips are first nailed to the spindles, and afterward the strips are nailed to the 2 by 4 in. bottom rail and the 2 by 6 in. top rail. Since such

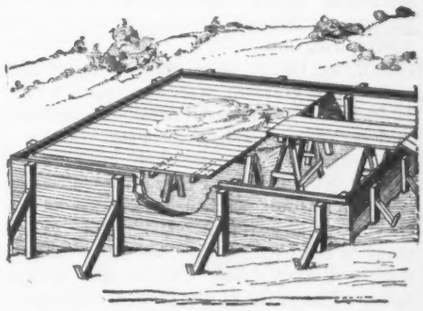


Fig. 5. Labor and often scaffolding can be saved by this method of mixing concrete

(Continued on page 139)

Making Your Loudspeaker Talk Up

An Easily Constructed Two-Stage Amplifier that Can Be Added to Any Ordinary Radio Detector

By Joseph Calcaterra
of POPULAR SCIENCE MONTHLY'S Radio Staff

NO SINGLE piece of radio apparatus, with the exception of a detector unit, is of greater value to both listener-in and experimenter than a two-stage audio-frequency amplifier unit.

By adding such a unit to a standard detector circuit, the strength of the incoming signals can be built up to a point where a loudspeaker can be operated with sufficient volume to fill a large room and, under favorable conditions, an entire house. It is then no longer necessary to distribute a pair of phones to each person until the assemblage takes on the aspect of a convention of telephone operators.

Distant stations usually come in best on earphones when a single stage of audio-frequency amplification is used with a detector unit. When a good aerial is used, two stages of audio-frequency amplification added to a detector circuit will bring in on a loudspeaker, loudly and clearly, stations 500 and more miles away.

The two-stage unit enables the experimenter to add amplification to any of the various types of detector circuits he wishes to try out without the necessity of incorporating two stages in each set.

If care is exercised in the construction, no difficulty will be experienced in its operation. Most of the trouble in amplifier circuits is usually due to the use of faulty parts, not properly tested before being placed in the circuit; to the incorrect location of parts and wiring, or to slipshod methods of construction.

Standard Circuit Is Used

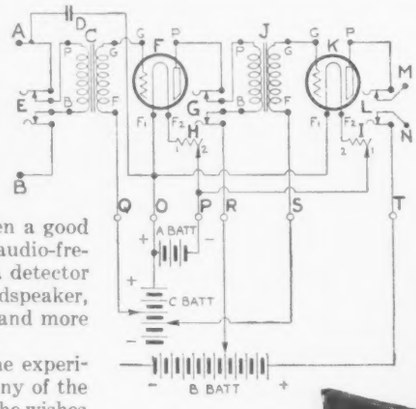
Before attempting to build the unit, read over carefully Jack Binns' article on troubles and their prevention, appearing elsewhere in this issue.

The circuit used in this unit is the standard, tried and tested audio-frequency amplifier circuit shown in the wiring diagram.

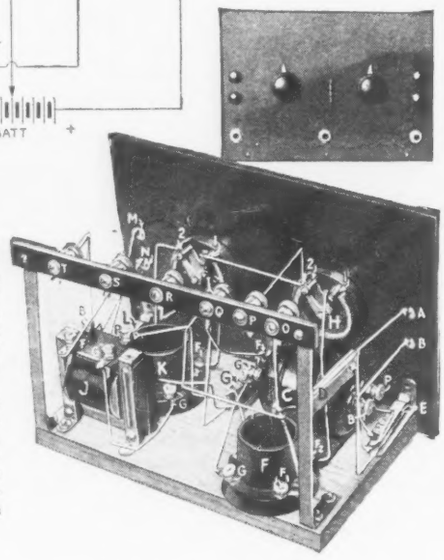
A 7 by 10 in. panel was used for this unit, but if you can spare the space, a 7 by 12 in. panel will make it easier to construct and perhaps give slightly better results.

A standard transformer coupling is used, the first stage being coupled to the detector circuit with a high-ratio audio-frequency transformer, while the second stage is coupled to the first stage with a standard amplifying transformer of low ratio. The ratio of the first transformer, *C*, may run as high as 10 to one, but that of the second transformer, *J*, should not be higher than about five to one. Two low-ratio transformers can be used, but two high ones are not advised. The transformers should be mounted so that they are at right angles to each other. Placing them at opposite corners will separate them as much as possible and reduce interaction between circuits.

Separate rheostats are used for each tube, this arrangement being more desirable than that in which one rheostat controls both tubes. The type of rheostats and tube sockets used will depend on the type of tubes used in the unit. *D* is a .001-mfd. fixed condenser. Three double-circuit jacks are used, the first, *E*, is for the plate circuit of the detector stage; the second, *G*, is for the first stage, and the third, *L*, is for the second stage.



Without tubes and batteries, this amplifier costs about $15



Wiring diagram of the two - stage unit (above) and views of the front and rear of the panel (at right). The letters on the large photograph correspond with those on the wiring diagram

This is the best arrangement when the unit is to be used with a detector circuit that has no jack. If your detector has a single-circuit jack, substitute a double-circuit jack, eliminating the necessity of using jack *E* in the amplifier unit.

Should you not use jack *E*, the *P* terminal of transformer *C* is connected with binding post *A*, and the *B* terminal of the same transformer is connected with binding post *B*.

Two posts should be added to the detector unit, opposite posts *A* and *B* of the amplifier unit. The top post of the detector unit, opposite post *A* of the amplifier unit, should be connected with the inside spring of the detector jack that makes contact with the outside spring connected with the plate terminal of the detector tube. The bottom post of the detector unit, opposite post *B* of the amplifier unit, should be connected with the inside spring of the detector jack that makes contact with the outside spring connected with the B battery.

The fixed condenser, *D*, is left as connected between post *A* and the positive of the A battery.

Since the negative of the B battery is automatically connected with the filament circuit through its connection with the filament circuit in the detector unit, no connection for the negative of the B battery is provided in the amplifier unit. This is to eliminate any possibility of shorting the A battery. If, for instance, the negative of the B battery were connected with the negative of the A battery in the detector unit, connecting the negative of the B battery with the positive of the A battery in the amplifier circuit would short circuit the A battery.

The same type of tubes used in the detector circuit should be used in the amplifier circuit; use 1½-volt, 3-volt, or 6-volt tubes throughout, or special circuit arrangements will be found necessary.

This unit can be used with the detector unit described last month, if the same type of sockets, rheostats, and tubes are substituted. It would be advisable, however, for greater convenience in connecting the two, to change the battery connections of the detector unit to the back of the set and place the phone postsso that they are opposite the input terminals of the amplifier unit.

Posts *M* and *N* are used to enable you to connect a loudspeaker or additional amplifier with the unit.

A general idea of the method used in routing the connecting wires for greatest efficiency can be gained by studying the photograph of the unit. Since the parts and terminals in the diagram correspond with the same markings in the photograph, the beginner can follow the wiring of the unit without trouble and gain experience in reading wiring diagrams.

How to Use the Unit

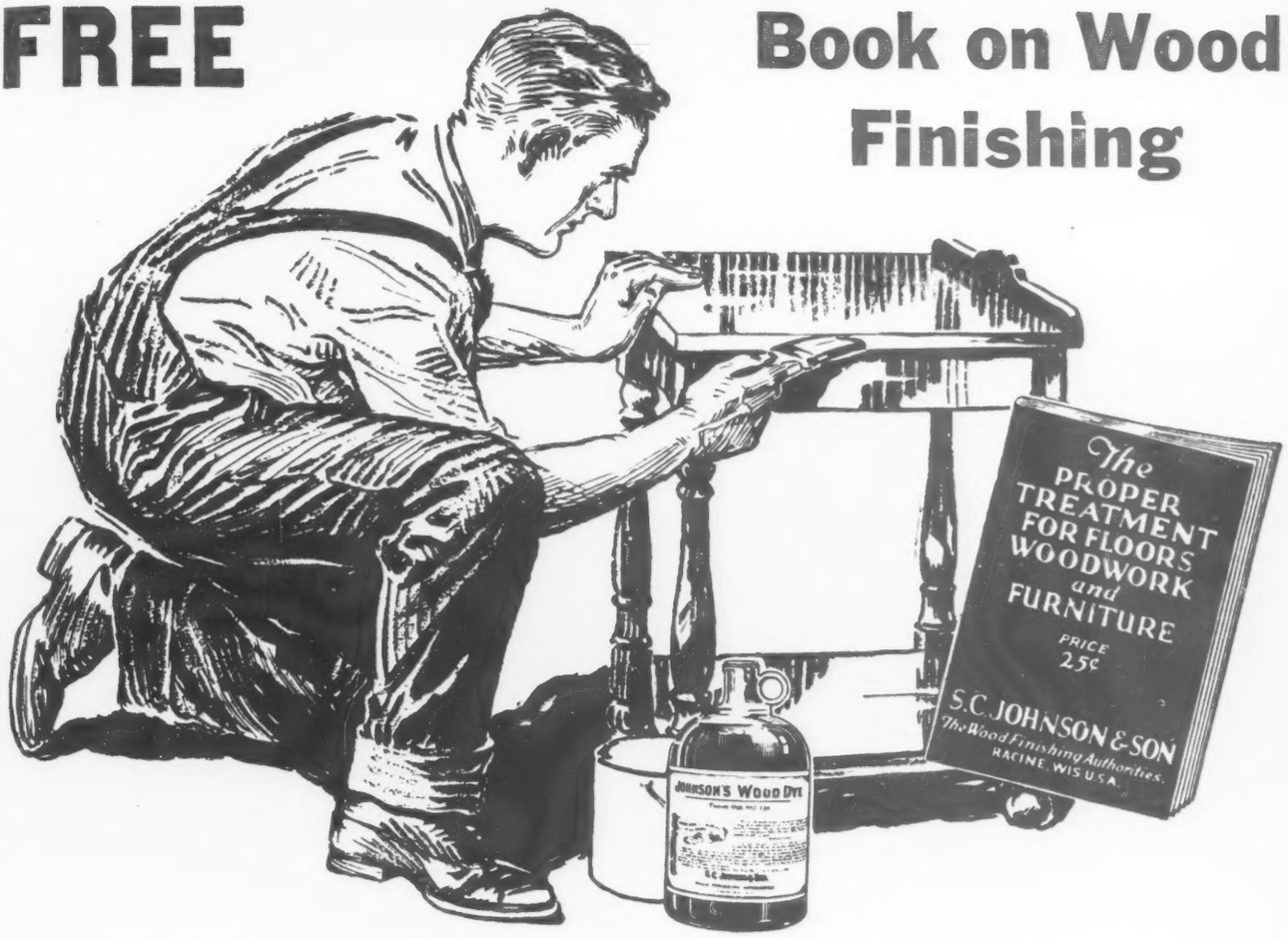
No trouble will be experienced in wiring the unit if the connections are made according to the following directions:

First connect the top spring of jack *E* with post *A*. Then connect the inside spring, which makes contact with the top spring, with the *P* terminal of transformer *C*. The bottom outside spring of jack *E* is connected with post *B*, while the inside spring, which makes contact with the bottom spring, is connected with the *B* terminal of the transformer.

A wire is next used to connect terminal F_1 of socket *F* with post *O* and another

(*Continued on page 110*)

FREE Book on Wood Finishing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Better Shop Methods

How Expert Mechanics Save Time and Labor

Secrets of Success in Handling Taps and Dies

By Joe V. Romig
Tool Designer and Builder

"WHAT'S the matter over here, Bill?" called Tom at the No. 9 tapping machine. "I've just broken another tap—the third this morning—and I don't know what is causing it."

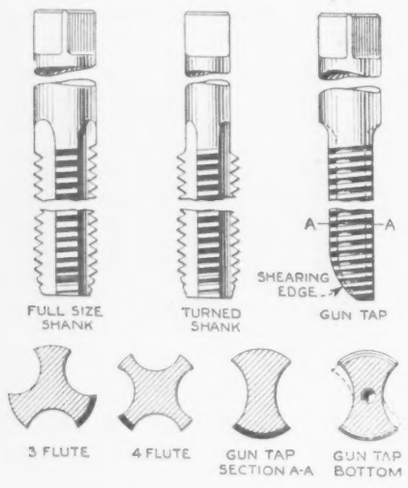
Old Bill shut down his machine and crossed over to where Tom was gazing perplexedly at a handful of broken taps. Just a glance gave Bill the solution. The work holder had slipped a trifle out of alinement, not enough to be obvious, but, nevertheless, sufficiently to make the tap run to one side and break. When the work holder was again located centrally with the tap, all trouble on No. 9 ceased.

Just as Tom, a pretty thoroughly experienced mechanic, was confronted with a tapping problem he could not solve, so many of us go about our work wondering why taps break, dies are ruined, and threads are torn. A few of Bill's suggestions to his fellow workers eliminated much of the tapping trouble in the shop where he worked.

"Not half of the so-called mechanics know how to lubricate a tapping job," was Bill's criticism at one time.

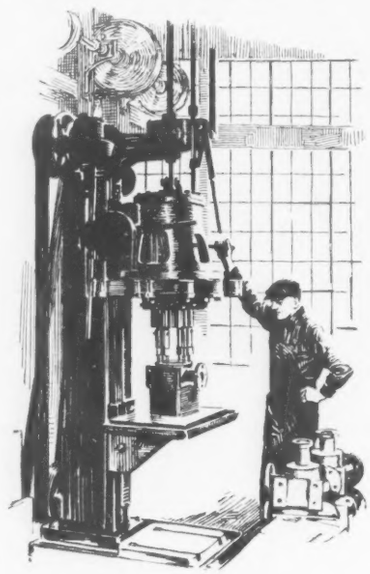
Most men use common machine oil for all hand tapping. On steel and boiler plate one should use a mixture of lard oil and white lead of the consistency of thin cream. It is well to have a can of this lubricant on hand at all times.

Cast iron and brass are best tapped dry. Whenever a lubricant is absolutely necessary with these metals, kerosene is the best to use. Lard oil, sperm oil,



Types of taps that can be made in an emergency without very much difficulty

tallow and graphite are excellent lubricants for steel. Soap compound or soapy water is also good. Any kind of lubricant used in tapping cast iron causes the chips to stick and often produces a rough thread. It must always be remembered



Multiple tapping, which requires the expert application of the principles Mr. Romig outlines in this noteworthy article

that the labor of hand tapping can be reduced considerably by the use of a good lubricant.

Screw-machine dies sometimes clog and twist off the stock, the latter being almost impossible to remove from the die. There are a number of causes for this, one being improper lubrication. When the lubricant stops flowing, heat is generated, the metal expands and the die cuts fast. Unless a proper lubricant is used, the same thing happens. A third cause is the use of dull dies. Hard stock is also likely to damage a set of dies, for it is not always possible to detect the hardness as it passes through the forming and turning tools.

A common occurrence is to have taps continue to break without having anything wrong with the machine or the set up. At one time several different makes of taps were tried out on a hard job of tapping 3/16-24 threads in tough steel, but many of them broke. The foreman checked up the speed, the set up of the work, the alinement, and found that a good lubricant was being used, and he was at a loss to know the reason for the breakage. Old Bill ran a file across one of the taps and solved the problem for him. The hardness ran uniformly from front to rear, and while the front end was just right to cut hard steel, the rear and middle were too brittle to withstand the strains and therefore broke.

By holding the taps with their square ends in a Bunsen burner flame, he drew the temper to a dark brown and graduated it toward the front to a light straw color. This in no way affected the hardness of the cutting threads, but it toughened the body so it could withstand the great twisting strains.

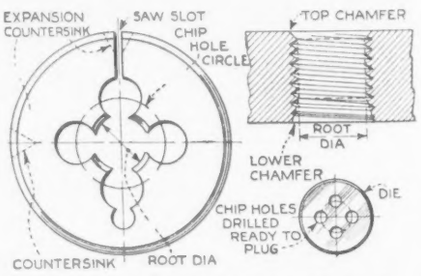
Where extreme accuracy is required on a threading job, a roughing tap or die should be followed with a finishing tool, which sizes the job by removing only a few thousandths of an inch of metal. Many manufacturers and builders claim that this should be done only by hand. This is, generally speaking, a reasonable claim, for hand operation allows the tool to float perfectly while the machine-operated tool forces the cut.

Where taps and dies are used on production threading, the man in charge should constantly study every circumstance that has a bearing on the tools themselves, their operation and manipulation. Hardness of stock, the speed of machine spindles, proper lubrication, and perfect alinement of the spindle with tap or die head are important items to be considered.

Alinement, both vertical and horizontal, is absolutely necessary to cut accurate threads. Many cases of tapered, one-sided, uneven, stripped, and thin threads are traceable to misalinement of the tap or die holder. To compensate for slight errors of machining, the floating tap and die holders were designed, and by their use many otherwise difficult jobs can be made within reasonable degrees of accuracy.

A perfect floating holder should float so that its axis is always parallel to the true axis of both work and holder. A holder which is held in a pivot at its rear will not act properly and is almost certain to cause poor work.

The amount of metal removed by a tap or die plays an important part in the threading operation. To cut a full thread, the maximum outside and minimum hole



Layout for a die, the first holes drilled and large detail of the top and bottom chamfers

diameters must be maintained. A reduction of the amount of metal removed makes the threading operation much lighter at a very small sacrifice of the strength of the thread. In fact, a die and

(*Continued on page 98*)

"What's the print allow you, Bill?"

"Two thousandths under — nothing over."

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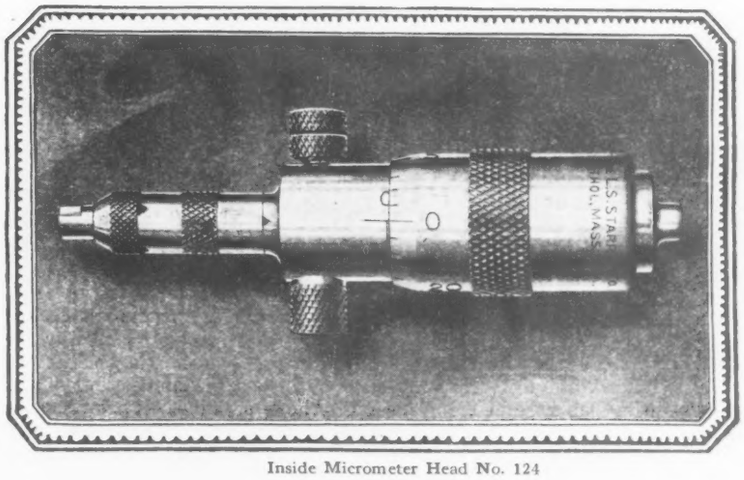

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STARRETT TOOLS — STARRETT HACK SAWS

Shortcuts for Men Who Work with Tools

PIPE-FITTERS and repair men usually carry their tools about in portable toolboxes of open design. While an old box rigged up with a leather strap for a handle will answer the purpose, the one shown in Fig. 1 is neater and will prove handier. The slanting sides eliminate the dark corners where small tools have a tendency to hide themselves. The legs raise the box out of the litter too often found on the floors and elevate the tools to a height where they can be conveniently reached.

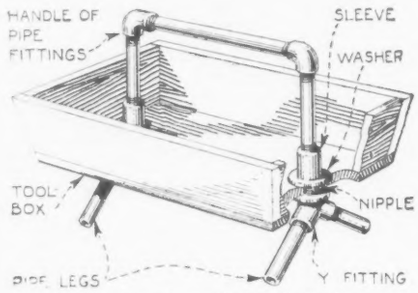

Fig. 1. Repairman's handy toolbox

A HANDY adjustable support that will find many uses around the shop is shown in Fig. 2. It is made entirely of old materials, the screw coming from a discarded piano stool. The pipe is cut to the desired length and fitted with a flange at one end. The pipe is then drilled at the other end with several holes to anchor the babbitt. The screw is babbitted in place. By raising a burr on the thread with a chisel, the screw will cut into the babbitt enough to make it turn freely. The pipe should be warmed at one end before babbitting, to prevent its blowing out before cooling. A V-block is fitted to one end of the piano-stool screw as shown.

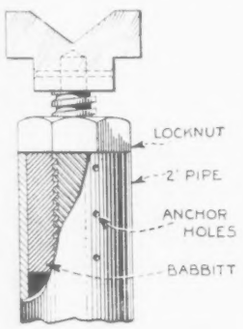

Fig. 2. Bar support

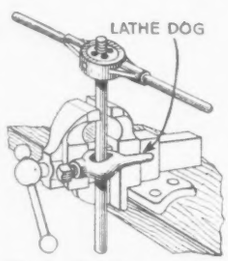

Fig. 3. Holding rod rigidly

IT IS almost impossible to cut a heavy thread with a hand die by holding the work in an ordinary vise, as the rod will turn in the jaws. By fastening an ordinary lathe dog to the work, as shown in Fig. 3, and allowing it to bear against the side of the vise, no difficulty will be encountered in holding the work rigidly.

A SATISFACTORY lathe dog for light work can be made from a discarded pulley by elongating the bore as shown in Fig. 4 and securing a drive pin to one of the spokes. The dog is equal to, if not better than, the common type, as the pulley rim prevents the lathe operator's clothes from catching in the driving lug. Moreover the dog is better balanced than the type ordinarily used.

THE drilling attachment shown in Fig. 5, was devised for drilling between the flanges of an I-beam where the usual ratchet wrench was too long to permit of its use. There are many places where such a drill will work to advantage.

A square bar of steel is drilled to accommodate the drill and fitted with a setscrew to clamp it fast. The opposite end is tapped to receive a pointed setscrew with which pressure is exerted on the drill. An open-end wrench is used to turn the drill. The same fixture can be used to tap the holes after drilling.

FOR the purpose of assembling quickly a large number of cap screws, the special screwdriver bit shown in Fig. 6 was designed. A split collar engages the head of the cap screw and prevents the blade from sliding sideways. The ends of the collar clamp the screw and permit of inserting it in the screwdriver bit previous to threading it in the hole. The screwed connection allows the collar to be removed when it is necessary to grind the edges of the blade. A locknut prevents the collar from working loose.

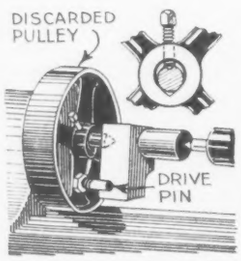

Fig. 4. Safety lathe dog

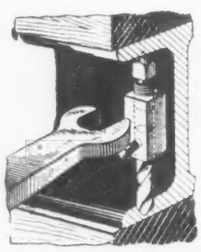
Fig. 5. For drilling

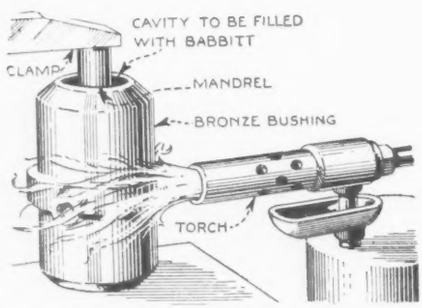

Fig. 8. Babbitting a worn-out bronze bushing

OFFSET socket wrenches can be made to operate more easily by adding a bent handle as shown in Fig. 7. A tubular section of brass or iron, from 18 to 20 in. long, is bent into the proper shape to form a crank and one end is riveted to the wrench. A door knob or other knob is attached to the other end.

WORN-OUT bronze bushings can readily be redeemed by relining the interior with a good grade of Babbitt metal. The worn bushing is chucked in a lathe and bored to ⅛ in. larger than the shaft. The bore should be rough and the size is not important. This bore is then tinned by using solder and soldering paste heated with a blowtorch.

After it has been tinned, stand it upright on a metal plate and place in its center a piece of smooth steel a trifle smaller than the shaft, as shown in Fig. 8. Clamp the steel piece upright and center the bushing. Then heat the bushing with the blowtorch and drop pieces of Babbitt metal into the cavity. The metal will melt and upon cooling, the babbitt and bronze will be knitted by the tinned surface. When cool, knock out the mandrel, chuck the bushing in a lathe, and ream to proper size.

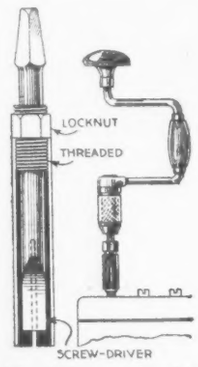

Fig. 6. Screwdriver bit

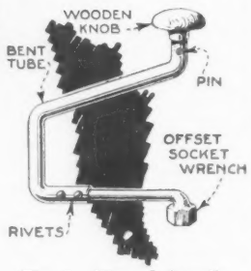

Fig. 7. Wrench handle

INDIRECT daylight can often be utilized in dingy rooms to improve working conditions for draftsmen or mechanics who have to depend upon their eyes a great deal. This was accomplished by one engineering company by silvering 15-in. wide strips of plate glass and placing them on the window sills so as to reflect daylight against the ceiling, which was enameled white. The walls were repainted a lighter color and the improvement was such that artificial lights were unnecessary the greater part of the day.

AN OPENING die can be used in an emergency to clear the burrs off the damaged threads on hardened or semi-hardened shafts. An ordinary die will not do the work because it is difficult to start it, but by placing the open die over the end, closing it on the good threads, and then backing it off, the damaged threads can be cleaned.

FOR removing broken studs and bolts, a special tool can be made from a left-hand twist drill, ground to a taper to give the sides a small amount of clearance. The end is cut square and then annealed, rehardened, and drawn until it has become a light blue.

Drill a hole into the broken stud large enough to allow the tool to be started and then run it in with a tap wrench until it takes a grip.

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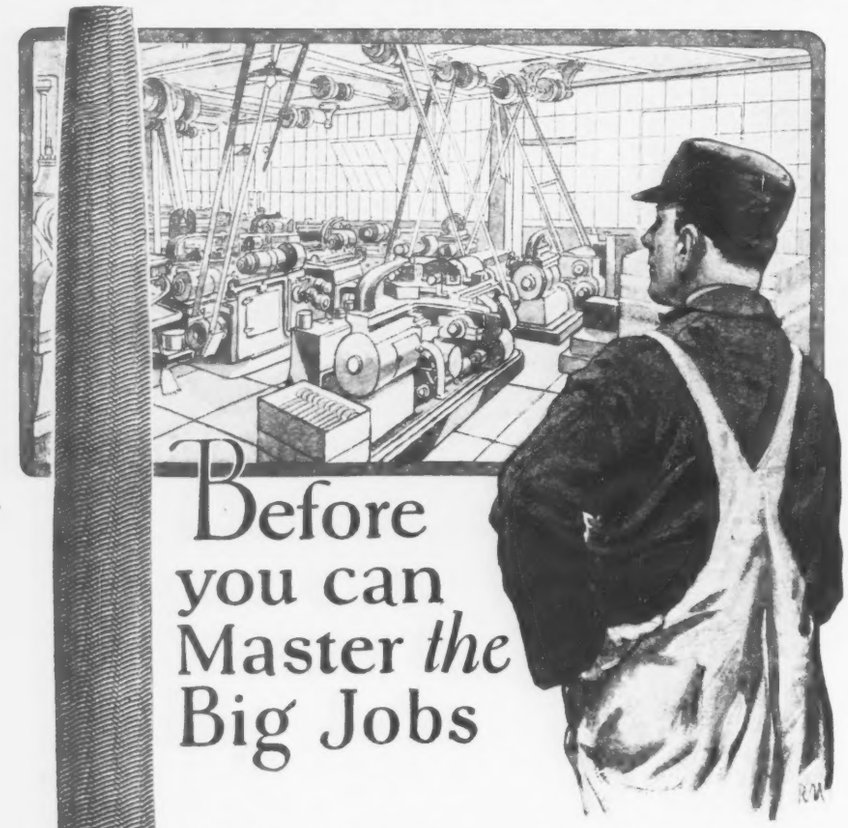

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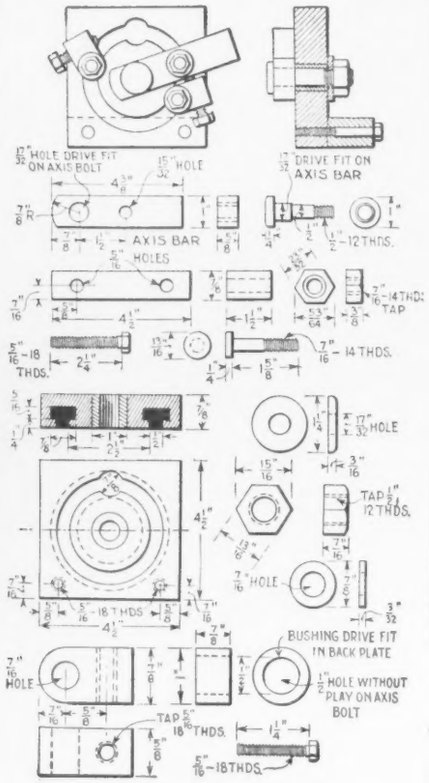
IN THE average shop not equipped with means for dressing angularly the wheel of a surface grinder, the usual method is to clamp a parallel to an angle iron and run the diamond block up and down on this. Not only is the accuracy difficult to obtain by such a method, but it is a tedious job.

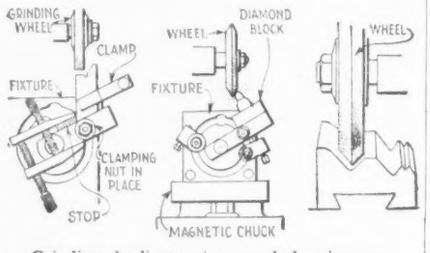
By constructing the fixture illustrated, the operation of dressing wheels is simplified materially. The top and sides are made square so as to permit the use of a bevel protractor for setting the axis bar. The axis bolt, which is forced into the bar in a press, is made so as to fit the bushing in the back plate tightly. Whenever the joint becomes too loose to remain fixed, the bushing can be renewed. The T-slot passing through the axis bar is utilized for clamping after fine adjustments are made by means of the adjusting fixture screws. For fine work the fixture can be set by means of a sine bar.



Details of base, back plate, axis bar, adjusting fixture, and the necessary bolts

The whole fixture, excepting the axis

(*Continued on page 94*)



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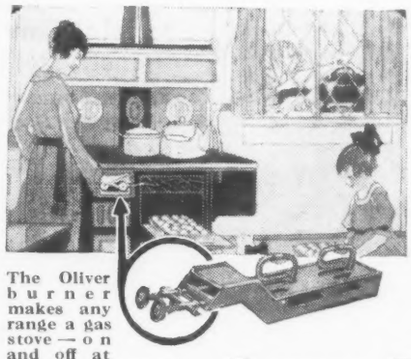

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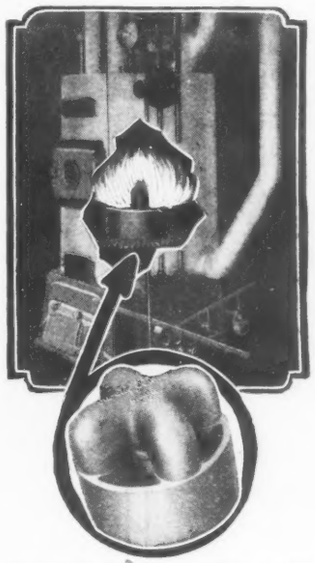

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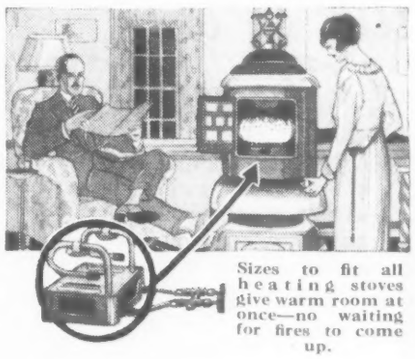

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☐ Coal Range ☐ Heating Stove ☐ _____ Furnace (Specify Steam, Hot Water or Hot Air)

Name .....

Address ..... Co. .....

City ..... State .....

☐ If interested in selling in full time or spare time check in square here.

Be Sure of a Beautiful Finish

When the manual labor is done on a medicine chest, table, swing, flower-box, or any useful article for the house that your hands have contrived—when it is time to apply the finish—then choose wisely so that the finish will enhance the beauty of your handiwork.

And whether you want to finish the piece with varnish, stain or enamel, you will find among Lowe Brothers Paints and Varnishes a product expressly made for that purpose—a product that you can be sure will produce a finish of lasting beauty.

For fifty years Lowe Brothers Paints and Varnishes have been used by the amateur workman and craftsman furniture finisher. There is one dealer in your community—The Lowe Brothers Dealer—who can supply you with these famous products.

Visit this dealer. He will not only supply you with a specifically prepared paint or varnish, but he will give you expert advice as to how to use it.

Linduro Enamel
Vernicol Stain
Automobile Color
Neptunite Varnish

With these four splendid products in your house you will be prepared to put a permanently beautiful finish on any piece of work you may make. The Lowe Brothers Dealer in your town can supply you with one or all of these products.

THE LOWE BROTHERS COMPANY
Dayton, Ohio *Factories* Toronto, Canada
BRANCHES IN PRINCIPAL CITIES

Lowe H.S. Brothers
PAINTS & VARNISHES

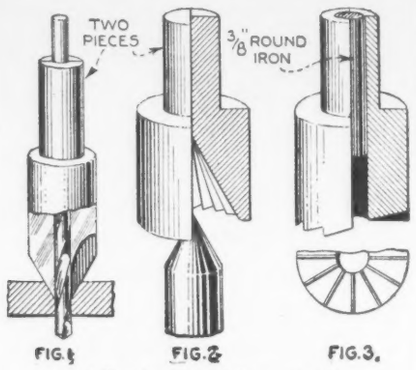
Angular Dresser Saves Time

(*Continued from page 90*)

bolt, is left soft and must be ground all over. The T-slot is cut on a milling machine by means of a circular attachment or it can be done on a spiral head. The back plate and base plate can be either cast iron or machine steel.—HENRY S. LARABY.

Special Reamers and Cutters Constructed in Two Parts

SPECIAL reamers are often useful in the machine shop. Figure 1 shows a tool for drilling and countersinking at one operation. A piece of round steel is shouldered at one end, drilled through the center to fit the drill, and cut in half through the center. It will accommodate three sizes of drills, such as 3/16, 7/32, and ¼ in. A cutting bevel is ground on the edges of the reamer and the drill and



A drill and countersink, a cutter for pointing rods, and an end mill

reamer are clamped together in a drill chuck. The split reamer adds to the rigidity of the drill and reduces breakage.

Figure 2 shows a two-piece pointer that would be difficult to make in one piece. Before making the cutting edges the reamer is cut in half, and each piece is finished separately.

An end mill—also made in two sections—is shown in Fig. 3. A hole passes down through the center of the tool into which an iron rod of any desired length may be placed to space the halves properly. When working on tenons that are to be finished at a definite length, the rod will act also as a stop.—O. W. MIELENZ, Philadelphia, Pa.

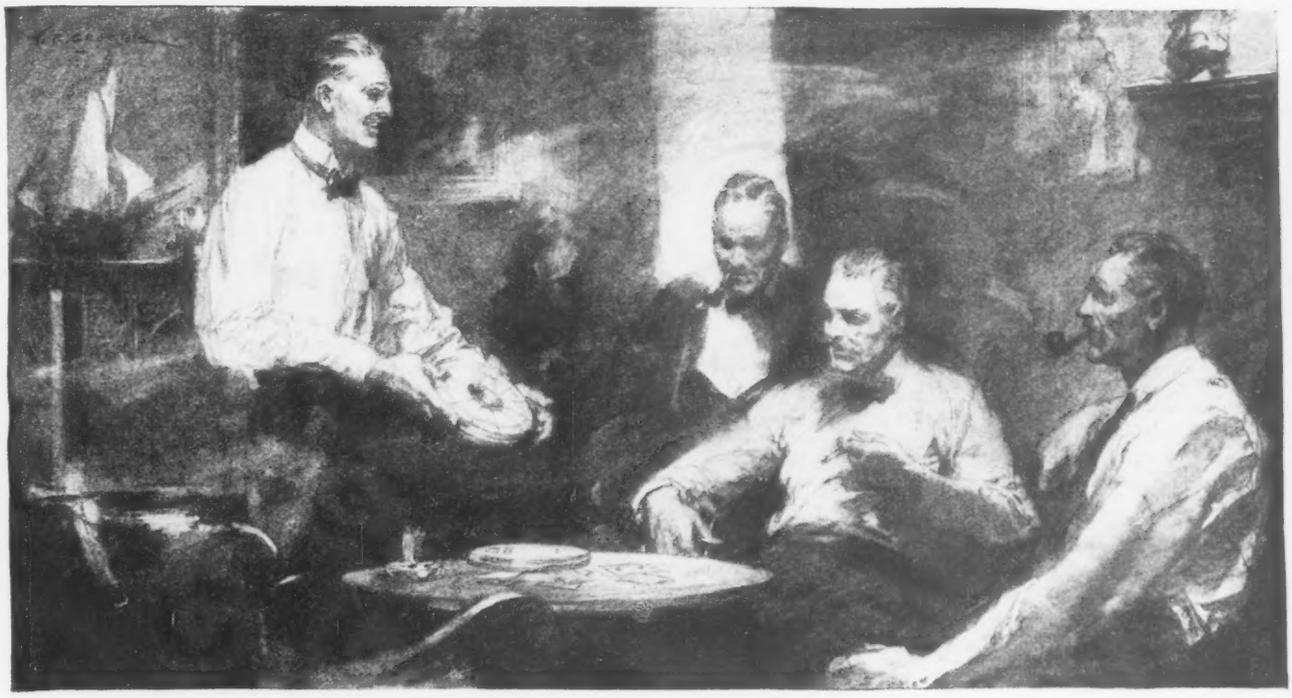
On Next Month's Schedule

AN INSPIRING article on success in the shop, by M. E. Duggan, one of the best known pattern-makers in the United States.

W. Burr Bennett, an automotive engineer, describes a connecting rod reamer that is useful for the small automobile repair shop.

Other articles of practical value to the shopman will be "Making Inserted Blade Lathe Tools," "Fitting a Small Tool Vise with a Dual Purpose Base," "A Depth Gage for Simultaneous Drilling and Spot Facing," and "A Hammer Impact Key Puller."

"Making the Most of Boring Tools" and "What a Machinist Should Know about Hardening," are two longer features scheduled for early publication.



Get this, men-

A complete assortment of the world's finest smoking tobaccos — sent to any smoker anywhere — *on* 10 *days approval*

A new idea for Pipe-Smokers: 12 famous tobaccos, packed in a handsome Humidor—shipped to you direct to help you find the soul-mate for your pipe.

GUARANTEED BY
The American Tobacco Co

MOST men have written their John Hancocks on a lot of "dotted lines." But, if you're a pipe-smoker, we'll wager that you've never signed a fairer, sweeter contract than the little coupon at the bottom of this page.

Just a few strokes of your pen—and you can end your quest of years for a perfect smoking tobacco—drawing dividends for life in unalloyed pipe-satisfaction.

A $3.05 Test for $1.50

If you were to try all 12 of these tobaccos in full size packages, the cost would be:

Blue Boar	.25
Capflan	.30
Imperial Cube Cut (Medium)	.30
Imperial Cube Cut (Mild)	.30
Old English Curve Cut	.15
The Garrick	.30
Carlton Club	.15
Yale Mixture	.25
Three Skates	.25
Lone Jack	.10
Willi Lalakia	.45
Louisiana Perique	.25
Total	$3.05

But through the *Humidor Sampler* you get a liberal "get acquainted" quantity of each for $1.50

But we are getting ahead of our story.

The average pipe-smoker is the greatest little experimenter in the world. He's forever trying a "new one," confident that some day he'll find the real affinity for his pipe.

Knowing smokers as we do—and knowing tobaccos as we do—we felt that we'd be doing a friendly turn for everybody if we found a way to settle this question once and for all, to the satisfaction of every smoker.

So we created the *Humidor Sampler*.

Into a bright red lacquered humidor case, we have packed an assortment of twelve famous smoking tobaccos—covering the whole range of tobacco taste.

To test these 12 tobaccos is to go the whole route in delightful pipe tobacco experience, trying out every good flavor and aroma known to pipe connoisseurs.

There are myriads of different *brands* of smoking tobaccos on the market. But of them all, there are 12 distinctive blends which, in our opinion, stand in a class by themselves for superlative individuality of flavor, aroma and smooth, sweet, even quality.

These twelve decisive blends—the twelve "primary colors" of tobaccos—have been selected for the Humidor Sampler. When you have tried these twelve, you have tried the best; if your tobacco-ideal is to be found anywhere, it must be one of these.

Ten-Day Approval Offer

We are eager to send the Humidor assortment to any smoker, anywhere, on ten days' approval.

Send no money. Just sign and mail the coupon. That will bring you the Humidor assortment direct from our factories to your den. When the postman brings the package, deposit $1.50 with him, plus postage.

If a ten-day try-out of these tobaccos doesn't give you more real pipe pleasure than you've ever had before, besides revealing the one perfect tobacco for your taste—the cost is on us.

Simply return the Humidor, and you'll get your $1.50 and the postage back *pronto*—and pleasantly. The coupon is your obedient servant; use it.

Send No Money—Just Mail Coupon

The American Tobacco Co., Inc.
Marburg Branch, Dept. 37
Baltimore, Md.

Please send me, on 10 days' approval, one of your Humidor Samplers of twelve different smoking tobaccos. I will pay postman $1.50 (plus postage) on receipt—with the understanding that if I am not satisfied I may return Humidor in 10 days and you agree to refund $1.50 and postage by return mail.

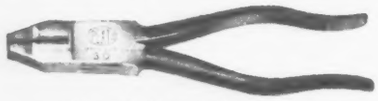
Name .....

Address .....

Note:—If you expect to be out when postman calls you may enclose $1.50 with coupon and Humidor will be sent to you postpaid.

Another Popular Pexto Item—Samson Ratchet Bit Brace with Ball Bearing Chuck and Head.

Good Tools Make Good Work Easy—

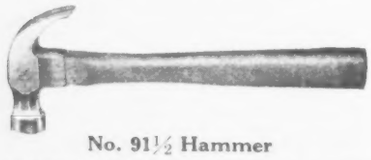


No. 30 Box Joint Plier

Drop forged steel, raised cutters, square opening in back, perfect fitting joint, easy action.

1819 Original Snip

Forged from best grade steel, they have given satisfaction for over one hundred years



No. 91½ Hammer

Drop forged steel, heat treated and tempered, excellent finish and properly balanced.

No. 3 Solbar Screw Driver

Forged steel bar runs entire length. Fluted hardwood handle securely held.

To take pleasure in your work you need good tools, tools that will do the job required of them.

PEXTO Tools are backed by over a century of tool making experience. They are of first class quality and fully guaranteed.

The line consists of Bit Braces, Auger Bits, Squares, Chisels, Hammers, Hatchets, Pliers, Monkey and Pipe Wrenches, Angle Wrenches, Screw Drivers, Snips, Compasses, Pruning Shears, Dividers, Calipers, Pincers, Soldering Coppers, Nail Sets, and many other small tools.

Booklets covering our important lines are available for free distribution.

PEXTO TOOLS are carried by practically all progressive dealers.

PEXTO

WORTH WHILE TOOLS

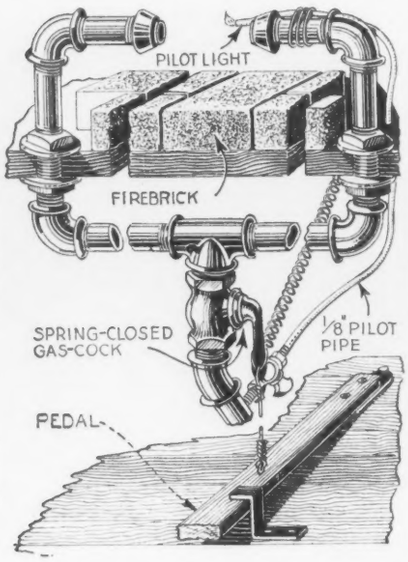
The Peck, Stow & Wilcox Co.

Southington, Conn., U. S. A.

Shut-Off Pedal and Pilot Light Improve Shop Blower

THE blower in a shop is usually the cause of much annoyance, either because the gas is turned on when not in use, thereby causing waste, or because it is out and matches are not handy for lighting it.

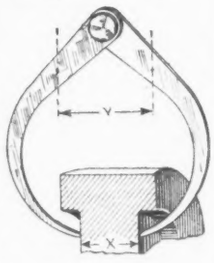
By attaching a pilot light and pedal control to it, as illustrated, this waste and delay are eliminated. A spring is attached to the handle of the cock, as shown, to hold it closed, and a wire is led from the handle to a pedal. By pressing down the pedal and hooking it under a bracket on the floor, the gas is allowed to flow to the burner. When the pedal is released, the spring closes the cock.



To turn on this blower, the pedal is pressed down and caught under the bracket

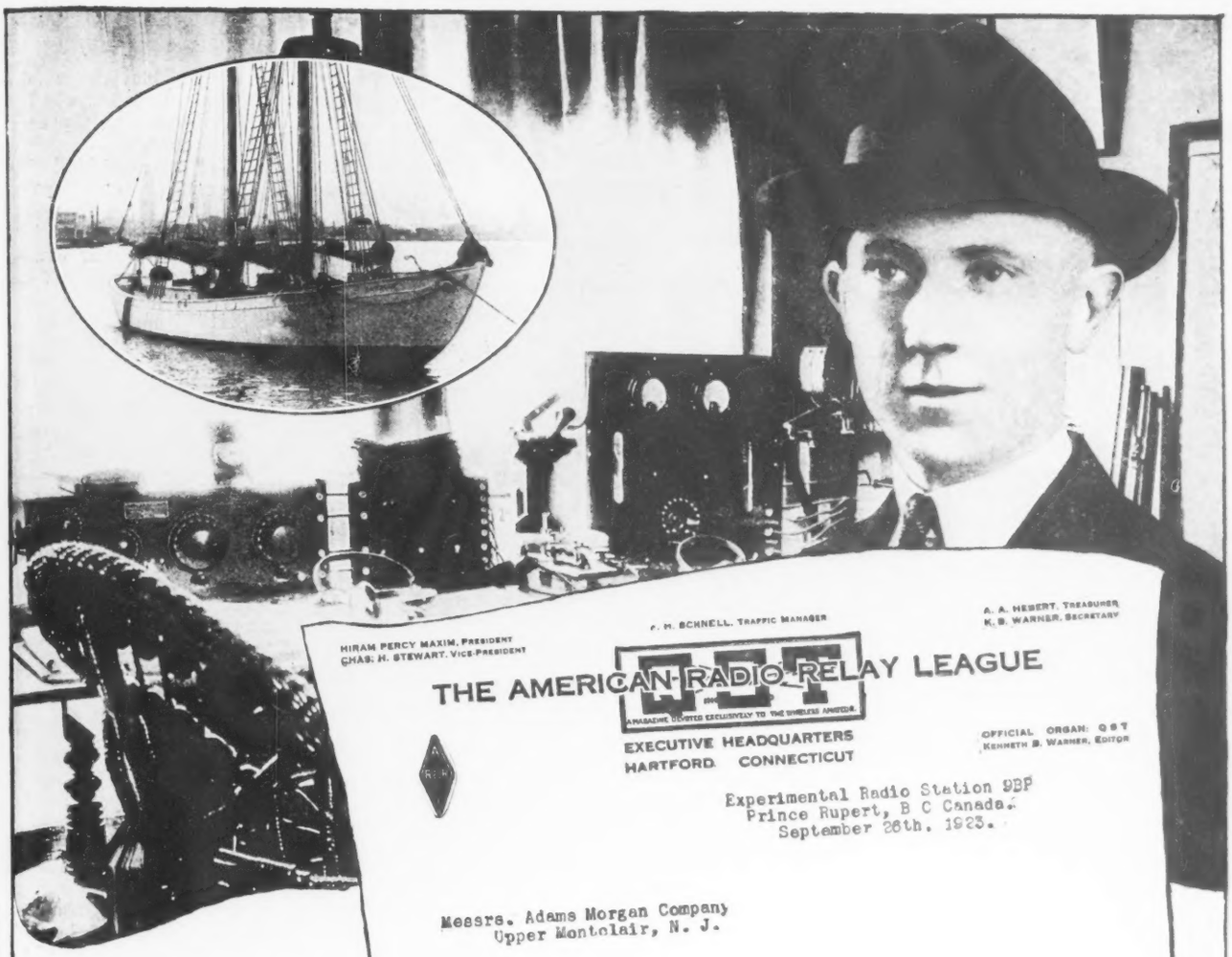
A pilot light is led out to the nozzle from the gas pipe in rear of the main supply cock. A small cock in this line regulates the amount of gas flowing to the pilot at all times so that there is always a flame available when the blower is needed.

Calipering Flanged Work



AN EASY way to measure the thickness of a web difficult of access is that illustrated. First, make prick-punch marks on the legs of a pair of outside calipers, as shown. Pass the points over the flange and set them against the surfaces of the web. Then scale the distance *Y*. Now remove the calipers, move the legs together until the punch marks are *Y* distance apart, and the distance between the points will represent the thickness of the web *X*.

DUST on a concrete floor can be prevented by painting it, when perfectly dry, with boiled linseed oil thinned with gasoline. Several coats should be given until the surface is glossy.



HIRAM PERCY MAXIM, PRESIDENT
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K. B. WARNER, SECRETARY

THE AMERICAN RADIO RELAY LEAGUE

QST
A MAGAZINE DEVOTED EXCLUSIVELY TO THE WIRELESS AMATEUR

EXECUTIVE HEADQUARTERS
HARTFORD CONNECTICUT

OFFICIAL ORGAN: QST
KENNETH B. WARNER, EDITOR

Experimental Radio Station 9BP
Prince Rupert, B C Canada.
September 26th. 1923.

Messrs. Adams Morgan Company
Upper Montclair, N. J.

Dear Sirs:-

I have advised you before that I am very pleased with the results of my "PARAGON APPARATUS" but here is another victory for "PARAGON APPARATUS" which I feel you will be interested to know.

The MacMillan Arctic Expedition which left Wiscassett, Maine on June 23rd. on board the radio equipped Schooner "Bowdoin" planned to keep in touch with the outside world by amateur radio. This they were able to do until they got North of Disco Island, Greenland. After going North of that point nothing was heard of the expedition. And all interested became worried at the ship's apparent silence. The Chicago Radio Laboratory on this account offered a duplicate of the receiving apparatus aboard the "Bowdoin" as a prize to the first amateur to get into communication with the Arctic Expedition. This prize I have had the honor to win with the aid of my PARAGON Type RA-10 Regenerative Receiver and PARAGON Type DA-2 Detector-Amplifier.

Since first getting into communication with the "Bowdoin" expedition(who are in winter quarters frozen in at Refuge Harbour, which is ten miles North of Greenland Latitude 78.30 North, Longitude 72.30 West) on September 7th. I have had a working schedule with the operator and have copied one 600 word and one 181 word press message from them addressed to the New York World, together with dozens of private messages from the expedition and a complete list of amateur calls heard (a total of 546 calls) by the "Bowdoin" from July 28th to September 20th. and have forwarded all of these messages to their destinations.

When you consider that the expedition has heard hundreds of amateur stations in the Arctic but that my station has been the only one with whom they have been able to communicate, I consider this quite a record for "PARAGON APPARATUS" and am glad to be able to advise you how proud I am of my receiving apparatus.

Yours very truly,
Jack Barnsley.

MacMillan's Link with Civilization

A Paragon Radio Receiver is the most dependable link between MacMillan's courageous explorers and a civilization eager to hear of their doings.

Read this letter from Jack Barnsley whose Paragon Receiver has been picking up these vitally important messages, picking up every one, and getting every word clearly.

A Radio Receiver could have no higher recommendation.

Illustrated Bulletins on Paragon Radio Products are yours for the asking.

ADAMS-MORGAN CO.,
18 Alvin Avenue,
Upper Montclair, N. J.

Then and there He was Convinced—

There was a mechanic who said he could get other tools than "Brown & Sharpe."	***He Could***
He said, "I'll try a new Micrometer of another make."	***He Did***
He thought that this other tool would be just as reliable as a Brown & Sharpe.	***It Wasn't***
His work was not as good—and the tool was to blame.	***He was dissatisfied***
Finally he made up his mind to buy a Micrometer that he *knew* he could rely on—and it was a Brown & Sharpe.	***He has used it ever since***

BROWN & SHARPE TOOLS

are made in the largest factory of its kind—their accuracy, improved design, long life and quality have made them the "Standard of the Mechanical World."

Catalog listing over 2,000 different tools, with discount sheet, sent on request. Send for it today.

BROWN & SHARPE MFG. CO.
PROVIDENCE, R. I., U. S. A.

Success with Taps and Dies

(*Continued from page 86*)

a tap will cast up and burr the metal so as to make practically a full thread even though a small allowance on tap or die diameter has been made.

It is essential that the right kind of tap be used for a particular job. Taps are made with two, three, and four flutes in the smaller sizes and six or eight flutes for the larger diameters. For extreme accuracy a gun tap, with only two flutes, should not be used, but occasionally a gun tap will work well on a difficult, rough job. The effect of the various kinds of taps on different work should be studied. Spiral fluted taps clean out the chips nicely and all other taps should have proper hooks on the cutting teeth to afford chip room.

Accurate Taps Essential

Most careful workers have their own particular set of taps which they keep standard on the leading teeth and maintain with a back taper. Such taps pull easily and cut accurately, while a tap with a reverse taper will choke and pull hard, making an imperfect thread. Such mechanics never use a tap or die with broken teeth except in an emergency and then only after the teeth have been ground down. Neglect to grind the broken teeth almost always results in torn threads.

There are occasions where even a damaged tap or die is not available. Lucky is the man who in this emergency can speedily make a tap for finishing a rush job.

In making either taps or dies, tool steel of the best grade should always be used.

For a plug tap a piece of steel of the proper width and length is cut off, chucked in a three-jaw scroll chuck and filed tapered for a distance of about three threads at the lower end. From that point it is back tapered (smaller at the shank) about .001 in. an inch. If a lathe is not available, the taper must be made as nearly correct as possible by hand.

The thread is then cut with a die opened up a small amount, and a second cut is made with the die set at the actual size. Soda water or compound is used as a lubricant so as to obtain a high polish on the finished surfaces of the threads.

Finishing and Hardening Taps

After deciding on the number of flutes, take a three-cornered file and gash them in roughly. A round file should then be used to finish the flutes accurately. In this way the flutes can be made deepest at the lower end, running shallow at the junction of the thread and shank. The tapered or chamfered threads at the lower end are backed off and a flat or square is filed on the end of the shank for the tap wrench.

The tap is now ready for hardening. Hold it in a hot flame (Bunsen burner) and heat to a bright cherry red. Then quench it in lukewarm or cool water, dipping the tap in vertically and stirring in circles, beginning with the smallest rotary motion possible and gradually increasing the circles. In this way all

(*Continued on page 100*)

Tycos Temperature Control

THE SIXTH SENSE OF INDUSTRY

WHEN the farmer's wife spun her own yarn and then wove the cloth, the human sense of feeling was sufficiently accurate for deciding when the wool had the right amount of "moisture content" to be made into yarn.

But with the development of wool manufacturing on a large scale—and all the allied textile industries—the human sense of feeling had to be replaced with something more accurate—something infallible.

This infallible sense so essential to the textile industry—the second greatest industry in the country—has been found in *Tycos*—the sixth sense of industry.

No longer is the dyeing and preparing of wool, silk, cotton and linen for manufacturing purposes dependent on the workman testing the "moisture contents" of these materials by feeling them.

By supplying a scientific and exact method of determining temperature and moisture contents *Tycos* Temperature Instruments have reduced to an *exact* science the conversion of animal and vegetable products into textiles.

In *every* manufacturing process *Tycos* Instruments for Indicating, Recording and Controlling Temperatures have taken the guess out of manufacturing. The use of *Tycos* Instruments insures the uniformity of results that is necessary to success in manufacturing and selling on a large scale.

Manufacturers

What do you make? What is your problem of applying *Tycos* "the sixth sense" to your manufacturing processes. For every process—in any industry—requiring heat control there is a type and style of instrument in the *Tycos* line that you need.

Write us and literature on any instrument or type of instrument will be sent you promptly. Or, if you prefer, our experts will advise you in the application of "the sixth sense" in your plant.

Canadian Plant
***Tycos* BUILDING**
TORONTO

Taylor Instrument Companies
Main Office and Factory
ROCHESTER, N. Y., U. S. A.

Tycos in the Home

Tycos *Office Thermometers*
An aid in promoting human efficiency.

Tycos *Bath Thermometers*
To enable you to get the most good from your bath.

Tycos *Home Set*
Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

Tycos *Wall Thermometers*
To help you maintain a temperature in your house conducive to good health.

Tycos *Quality Compasses*
To show you the right way in unfamiliar country.

Tycos *Fever Thermometers*
A necessity in every home.

Tycos *Stormoguide*
Forecasts the weather twenty-four hours ahead with dependable accuracy.

Tycos *Hygrometer*
To enable you to keep the humidity of the atmosphere in your home correct at all times.

The **SIX SENSES**
Feeling
Seeing
Hearing
Smelling
Tasting
and
Tycos Temperature Control

Your dealer will show them to you. Ask us, on a postal, for booklets on any of the above.

Tycos **and the MEDICAL Profession**
Tycos Sphygmomanameter, Pocket and Office type
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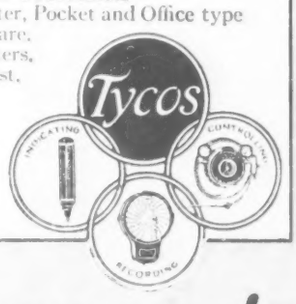
Bulletins on request.



Tycos Temperature Instruments
INDICATING · RECORDING · CONTROLLING

No. 677
RATCHET
BREAST
DRILL
Try this light-weight breast drill
See how easy the two-speed ratchet mechanism works. Changes of speed and changes of motion are made by a turn of a dial. Frame of aluminum alloy. Holds round-shank drills 0 to ½ inch.
The Goodell-Pratt catalog describes each of the 1500 Good Tools. Write for it—free.
Goodell-PrattCompany
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Toolsmiths
Makers of Mr. Punch
GOODELL-PRATT
1500 GOOD TOOLS

Success with Taps and Dies

(*Continued from page 98*)

sides of the piece will cool evenly without warping the metal.

The tap will then be as hard as glass and must be tempered. Hold the tap with a piece of wire, one end of which is wrapped around the threads, and pass the whole length of the tap through the flame, allowing the shank end to get the most heat. The shank will first turn yellow and then a straw color, the color going down toward the threaded portion. This can be observed best if the shank and the inside of the flutes are polished. When the end of the tap shows a straw color, quickly dip it in cold water. Taps hardened and tempered in this way will have hard cutting edges and tough shanks and bodies.

The general method of making tapered and bottoming taps is the same as for the plug taps described. The difference lies in the tapering of the blank. The tapered tap has the lower end turned straight for three threads, then tapers for six threads and is straight except for a .001-in. back taper the rest of the way. The bottoming tag has a chamfer on the lower thread only.

Steps in Making Dies

When making dies, a layout five or 10 times the size of the actual tool should be made first. This diagram then is reduced to actual size and traced on the blank. Before laying out on the blank, the latter should be sawed and faced on both sides to the thickness required.

The first holes drilled are the chip clearance holes. These then are plugged tightly with soft steel plugs, each one being a driving fit. The central hole is drilled then and reamed to size, taking care that the diameter agrees absolutely with the root diameter of the thread.

The chamfer of the lower end should taper out in three threads, while that on the upper end includes one thread only. The die then is tapped with a taper tap starting at the bottom or tapered side of the die. Lard oil provides a good lubricant for this operation. The finishing cut should be made with a bottoming tap.

A weakening hole next is drilled and the saw slot is cut from the inside, leaving a thin bridge on the outer circumference for the purpose of holding the metal rigid during the hardening process and preventing the die from warping. This bridge is filed away when the die has been tempered.

Countersinks then are made in the saw slit and one side to receive the points of the side and set screws respectively. At this time the chip hole pins are driven out and the rear of the lands are backed off with a flat file. The hooks or lips of the cutting edges then are touched up and clearance is filed on both top and bottom chamfers.

The die is now ready for hardening. Wrap a piece of wire around the thin section of the die and heat the die to a cherry red. Quench as in the case of the tap and draw the entire die to a deep straw color. The temper can be improved

(*Continued on page 102*)

asleep or awake

they're always growing

Man's whiskers, like the troubles of people who live beyond their means, are always growing. Clocks may stop, lecturers may pause to consider, but, day and night, as long as he lives, man's whiskers are always growing.

—From "The Hair Apparent," Part I, Chap. IV.

□ □ □

ACCEPTANCE of the fact that a facial briar patch is not likely to contribute to a man's success in scientific pursuits, in business, in love, or in any other worthy endeavor is spreading rapidly.

Most professional men, as well as most business men, now shave daily. This is the only means of keeping man's always growing beard in proper subjection.

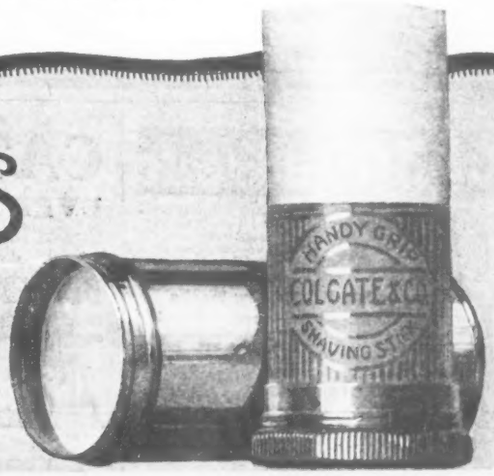
No matter how heavy your beard may be, or how tender your skin, you can shave closely every morning, and be comfortable, if you lather with Colgate's "Handy Grip" Shaving Stick. It makes shaving easy, and always leaves the face cool and refreshed.

The "Handy Grip" and metal container will last for years. After your first shaving stick is used up you can buy Colgate "Refill" Sticks for the price of the soap alone.

It is not uncommon for a Colgate Shaving Stick to last for a year or more in daily use.

Colgate's "Handy Grip" Shaving Stick is unequaled for putting comfort, convenience, and economy into the daily shave.

COLGATE'S
Shaving Stick
"HANDY GRIP" AND REFILL



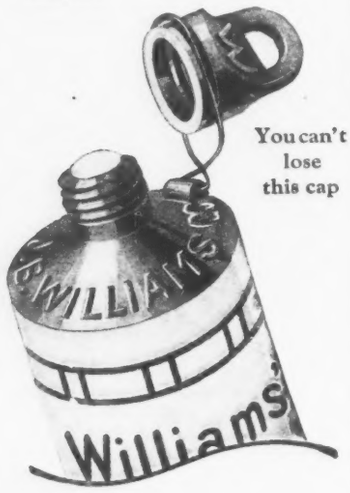
COMPARE the Williams' cap with any other. There's nothing like it. Compare Williams' in any and every other way:

You'll like its lather—uncannily swift in the way it softens tough beards. For years the envy of other shaving soap makers.

You'll like its purity—no coloring disguise is needed in Williams'. It is a natural white.

You'll like its soothing effect—no complexion soap in the world is more beneficial.

And last, there's the Hinged Cap! Add to your Williams' shave this "extra dividend" of a cap that you can't lose. Then compare.



You can't lose this cap

"That new hinged cap sure is a wonder"

Williams' Shaving Cream

Have you tried Williams' Aqua Velva? The new scientific formula for after-shaving use? Sample free. Write Dept. 102

The J. B. Williams Co., Glastonbury, Conn., The J. B. Williams Co., Ltd. (Canada), 1114 St. Patrick St., Montreal

$50-$300 a Week

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Success with Taps and Dies

(*Continued from page 100*)

by repeating the operation several times.

The weak section of the die should then be drawn to a deep blue, taking care not to change the temper of the lands. The bridge is also drawn blue and is later filed away. The blue temper increases the tenacity of the steel and makes the weak section act as a spring.

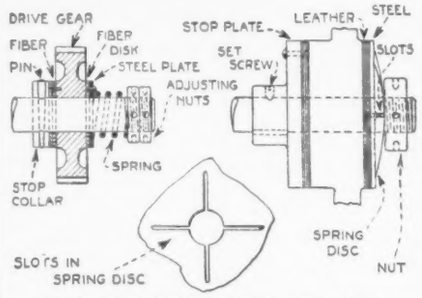
Correct proportioning of a die in relation to chip room, lip angle of the cutting edges, and the proper backing off of the chamfered portion of the thread are highly important features in the making of successful cutting and wearing dies.

All small taps and dies should be marked with their sizes before hardening.

"Slip" Flywheel and Gear Will Prevent Tool Breakage

COSTLY repairs and lost time can sometimes be prevented by fitting a production machine with a slip drive along the lines illustrated.

Hundreds of dollars were saved by such a revision in design of an automatic machine similar to a press, which had a heavy flywheel keyed to the drive shaft. Whenever the work caught or a foreign body dropped into the tools, the expensive set of tools was ruined and the machine placed on the idle list. These breakdowns have been



Typical installations of friction drive that slips when subjected to any unusual strain

eliminated and all later machines have been similarly equipped.

The driving flywheel in this case had a good-sized hub that was faced off on both sides. A cast-iron stop plate, to which was riveted a ¼-in. leather disk, was mounted on the inner side of the wheel and held in place on the shaft by a key and setscrew. A leather-faced steel disk was floated on the shaft on the outer side of the wheel hub as shown. This disk was forced against the hub by a large spring washer formed from ⅛-in. steel and tempered. To improve the springing qualities of this dish-shaped disk, four slots were made in it. A large nut on the end of the shaft was brought to bear against the spring disk.

The grip tension can be adjusted so that the flywheel will carry the load, but will slip when a blank or other object gets caught and binds the tools. In other words, the flywheel "gives" instead of the tools, which means longer tool life.

The illustration shows a "slip" gear mounting that is practically the same arrangement as the flywheel mounting described, except that a heavy coilspring takes the place of the dish-shaped spring disk.—C. M. WILCOX.

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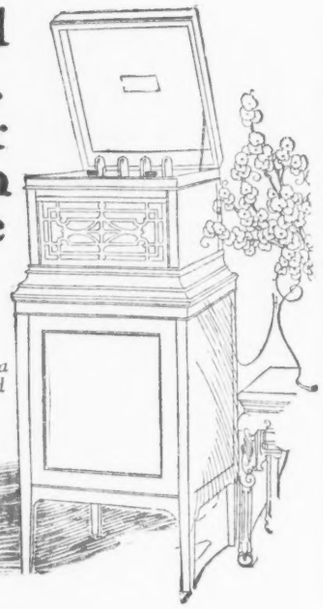

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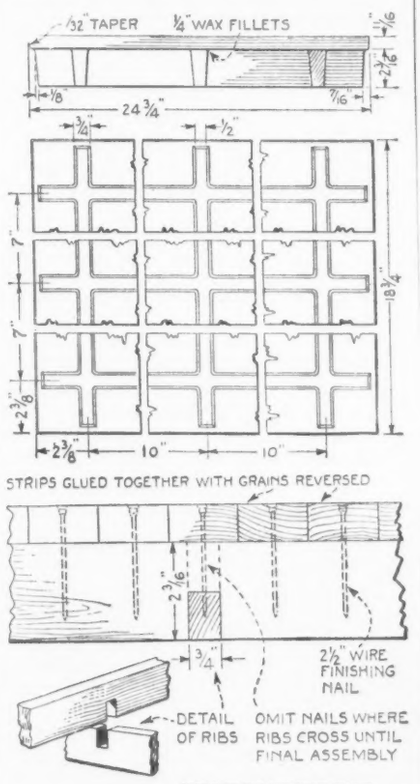
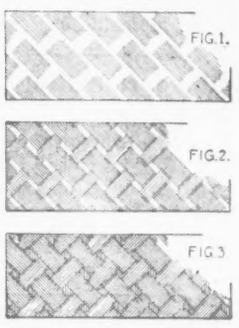
How to Make a Set of Accurate Cast-Iron Surface Plates

By Henry S. Laraby

A PRECISION surface plate is a luxury seldom found in the small shop. This is, of course, due to its high cost and to the notion that accurate surfaces are difficult to produce. For years I, too, labored under this impression, but finally decided to put my odd moments to better use by making a set of three. Once the pattern is completed and the castings are





A condensed assembly view of details of an 18 by 24 in. surface plate is shown above. Allowance has been made in the dimensions for the shrinkage of the castings. At the right are shown the three steps in scraping the plate to a true surface

made from it, the plate can be left for those hours when work is slack.

The pattern is made of white pine. Ten strips 25 in. long are planed accurately to a size of 1 9/16 by 15/16 in. Two other strips 1¾ by 15/16 by 25 in. are made to serve as side strips, being slightly wider so as to allow for truing up the top when completed. These are now laid side by side with the grain running in the same direction lengthwise so that the top can be planed properly. Also, the end grain should be reversed on every other strip to prevent warping of the whole when glued together. The strips are then glued together and allowed to harden. The top next is planed on one side.

(*Continued on page 106*)

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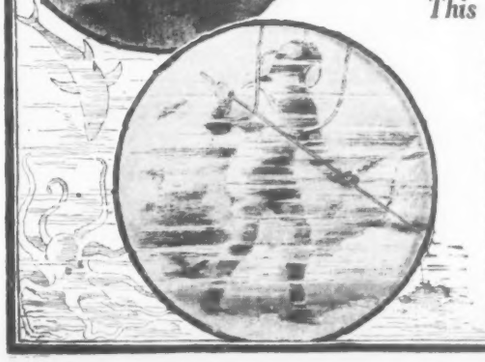

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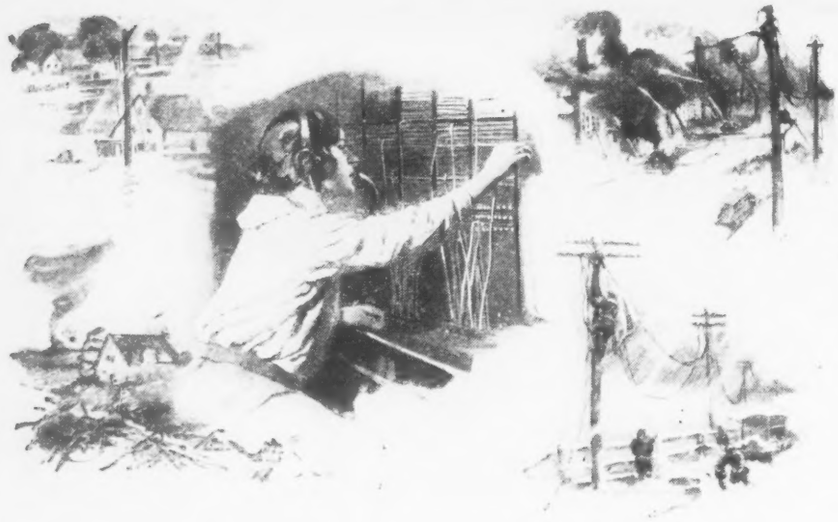

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It is right that the public should receive this type of telephone service, that it should expect the employment of every practical improvement in the art, and should insist upon progress that keeps ahead of demand. Telephone users realize that dollars can never measure the value of many of their telephone calls. The public wants the service and, if it stops to think, cheerfully pays the moderate cost.

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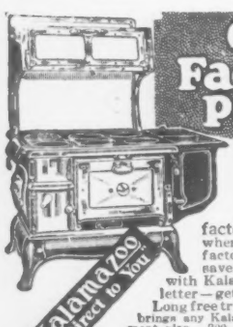

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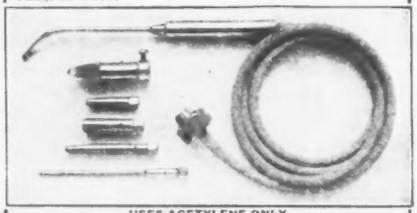

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How to Make Surface Plates

(*Continued from page 105*)

The ribs also are made of white pine, three being 2 3/16 by ¾ by 17⅞ in., and three, 2 3/16 by ¾ by 20⅞ in. These are planed down to the dimensions shown on the drawing of the finished plate, and notched half way.

The ribs are then glued and nailed to the smooth side of the top and the other side is planed, the sides are squared, and a taper is made on the edges all around the top. The dimensions of the top now will be sufficiently large to allow for shrinkage.

Next, smooth off the bottom edges of the ribs, sandpaper the pattern and shellac over all. After a day, put ¼-in. fillets of wax around the rib bases and give two more coats of shellac.

Finishing the Iron Castings

The pattern is now ready for the foundry, where three castings of gray cast iron should be made. These should be given distinctive markings before any work on them is done.

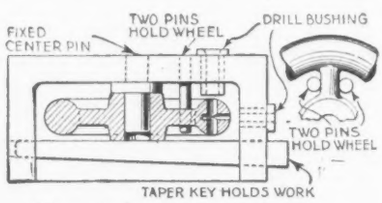
First the plates should be planed as accurately as possible. Then castings Nos. 1 and 2 are trued up by means of a straight edge and scraper. One of them is coated with Prussian blue or red lead and the two are rubbed together. In this way the high spots can be located and removed with a scraper.

Leaving No. 1 aside for the moment, repeat the operation with 2 and 3, but do not scrape 2 at all. By comparing 3 with 1 any errors are detected and an amount equal to half the error is scraped off each. Continuing in this way, rescrape 1 and 2, then 3 and 2, finally checking with 1 and 3. This is continued until all three check.

How the scraping should be done is indicated in Figs. 1, 2 and 3, on page 105. By this method a careful workman can make three very accurate plates in his leisure moments.

Jig for Drilling Handwheels

THE simple jig illustrated is for holding a handwheel while drilling holes in the rim. The taper key is removed and the wheel is placed on the center pin. Two pins then are placed in seats in the jig to hold the wheel by bearing against one of the spokes and the key is driven in, thus locking the wheel. Two drill bushings guide the drills.—J. H. MOORE.



Three pins locate the handwheel accurately and a taper key holds it in place

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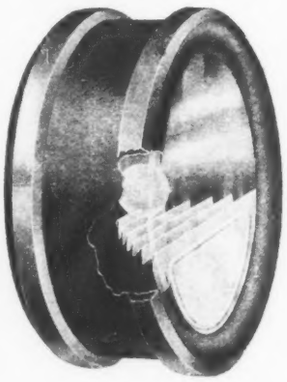

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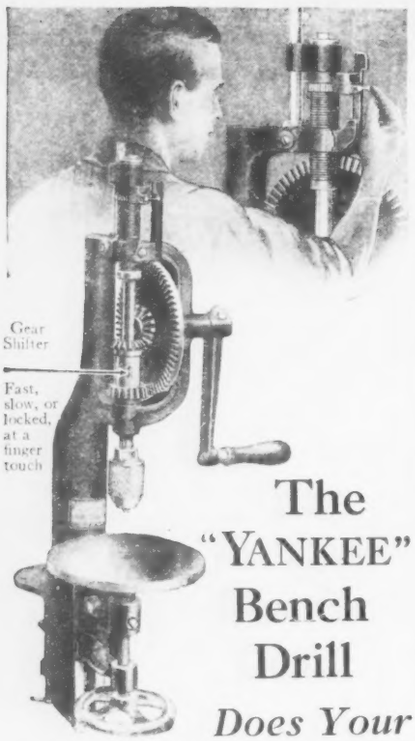

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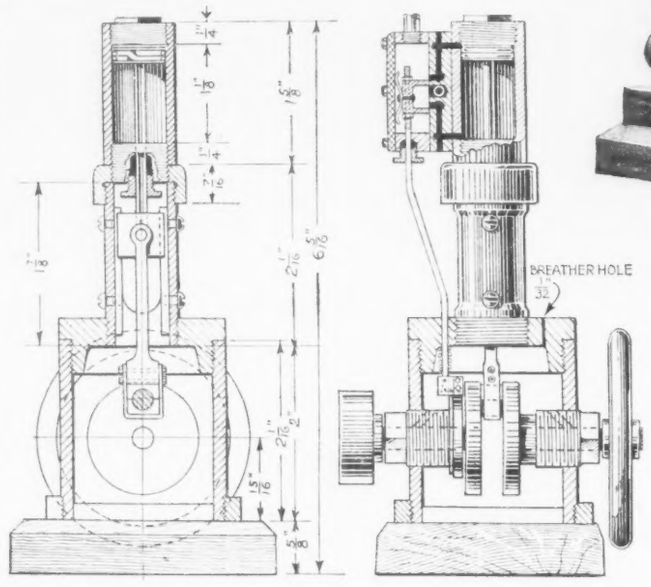
"YANKEE" TOOLS
Make Better Mechanics

Unique Steam Engine Is Simply Built from Cheap, Easily Obtainable Parts

By Frank N. Coakley

TO BUILD a small steam engine is the ambition of almost every home worker at some time or other. There is a peculiar fascination about engine building, even if the finished model serves for no other purpose than a curiosity or toy, but the majority of amateur mechanics are hampered because of lack of tools and material and the difficulty of making patterns for castings.

Here is a model engine, however, that requires no castings and no machine work. It is made mainly from pipe and pipe fittings with a few hand tools that are in almost every home workshop. A bench vise, breast drill, light hammer, a few files, small taps, and small drills are necessary, and the parts can be bought cheaply at hardware and ten-cent stores.



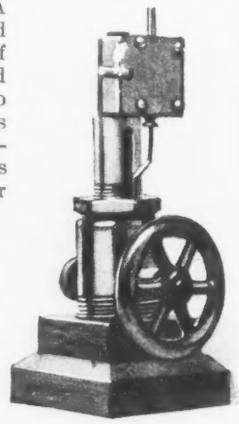
Made with hand tools mainly from pipe and pipe fittings, this small steam engine, described on this page, looks and runs like one of the expensive models that can be bought in the large stores

The cylinder proper is made from a piece of ½-in. pipe, through which a ⅝-in. reamer is run to give a smooth finish. This pipe, which is 1⅝ in. long, is tapped for ⅜-in. pipe or ¾-in. standard plugs at both ends.

The pipe plug used as the top cylinder head is filed down to ¼ in. in thickness and the square end also is filed down to leave only enough for a wrench hold when removing the top head. The bottom head also is made from a ⅜-in. pipe plug. The square end is removed entirely from this plug and a ¼-in. hole drilled ⅜ in. deep and tapped for the stuffing-box gland. The gland and bottom head are drilled for a ⅛-in. piston rod.

The piston rod is threaded at each end, one for the crosshead, the other for the piston. The piston is made from a ¼-in. length of brass rod ⅝ in. in diameter. A short length of 1/16-in. fuse wire is used as a piston ring. This allows for a small flange on each side of the piston to hold the ring in place. Common twine can be used as a packing for the stuffing box.

The crosshead is made from a piece of brass, ½ by 9/16 by 5/16 in. thick. A ⅛-in. hole is tapped in one side and another ⅛-in. hole drilled through the side for the connecting rod. A groove is filed on both sides of the crosshead 3/16 in. wide to receive slides that are fastened with screws to the center body of the engine.



The center body of engine is made from a piece of ½-in. pipe, 1⅞ in. long. This pipe is threaded at both ends, and the cylinder is connected with the center body by a ½-in. pipe cap tapped for a ¼-in. pipe plug. When assembling at this point, care is to be taken that both parts are properly in line with each other.

This center body is provided with two openings opposite each other. They are 7/16 in. wide by 1¼ in. long and are made by drilling 7/16-in. holes on 13/16 in. centers and filing away intervening metal, preferably with a round file. The crosshead gibs are at right angle to these holes and are held in place by two ⅛-in. round head machine screws. These side holes are necessary for assembling the gibs, crosshead, piston rod, and connecting rod.

The connecting rod is made from a piece of 5/16-in. square steel 1⅞ in. long. After filing the top or small end to the desired shape, and drilling a ⅛-in. crosshead pinhole, a saw cut is made about ½ in. long. This is done to enable one to spread the ends, so that the connecting rod's upper end will straddle the crosshead.

The lower end is filed to 3/16 in. wide and left 5/16 in. thick. Two 3/32-in. holes are drilled for the connecting-rod strap bolts. The connecting-rod brasses can be made by clamping the pieces of

brass together and drilling a 3/16-in. hole for the crankpin. These brasses are held in place by the connecting-rod straps.

The crankcase of the engine is made from a piece of 1½-in. extra-heavy pipe 2 1/16 in. long. A ½ to 1¼ in. bushing is used as a connection between the center body of the engine and the crankcase.

One end of the 1½-in. pipe is tapped for the 1¼-in. bushing, while a standard thread is used for a square 1½-in. floor flange for the base. The four holes in the flange are used for connecting the whole with the wooden base.

The 1½-in. pipe is drilled and tapped 15/16 in. from bottom to center of holes for ⅜-in. pipe plugs. These plugs act as bearings for the crankshaft. Again care must be taken to drill these two holes in line with each other, as it would cause considerable difficulty if these two bearings were out of alinement.

Each of the ⅜-in. pipe plugs has a ¼-in. hole drilled through for the crankshaft, and ⅛-in. holes are drilled through the side of the plugs to act as oil holes. It is advisable to file both ends of plugs smooth and parallel with each other and, necessarily, at right angles to the shaft hole.

Crankshaft and Eccentric

The crankshaft is built of ¼-in. cold rolled stock and two disks 1 5/16 in. in diameter by 3/16 in. thick. A 3/16-in. pin is riveted between these two disks. The eccentric is fastened to one of them with the high side opposite the crankpin.

The eccentric moves the valve rod up and down through a small shoe, which is allowed to ride on the face of the eccentric and is held there by a small compression spring. The ⅛-in. valve rod is bent to the proper angle so as to line up with both holes and is threaded at both ends.

While not hard to make, the steam chest has the most work connected with it. The piece next to the cylinder and having the ports is made of brass, filed on one side to fit the side of the cylinder. For the top and bottom ports two 1/16-in. holes are drilled, as shown in the sectional view. The exhaust port is a 3/16-in. hole in the center of the block, and central between the upper and lower steam ports.

At least ⅛ in. of metal is to be left between the steam and exhaust ports. This distance governs the stroke length of the valve rod.

The center section of the steam chest is a hollowed out piece of brass of a size to suit the cylinder section. A hole is tapped on the upper side for a ⅛-in. steam pipe. The lower side is drilled ⅛ in. for the valve rod and drilled and tapped for the valve rod stuffing box.

The flywheel is 3 or 3½ in. in diameter. The wheel from an old valve can be used for this purpose. The pulley can be either grooved or plain, about 1 in. in diameter.

When assembled and adjusted, this model is a husky ⅝ by ⅞ in. steam engine and, for its efficiency and completeness, perhaps the cheapest small engine that can be built.

How to make an especially fine table for playing the fascinating Chinese games now so popular will be told in next month's Home Workshop.

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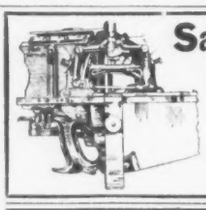

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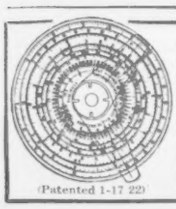

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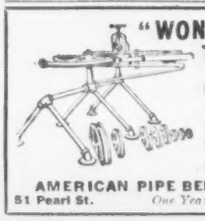

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Making the Loudspeaker Talk Up with Two-Stage Amplifier

(*Continued from page 84*)

wire to connect terminal F_1 of socket K with the wire just mentioned.

One terminal of condenser D is connected with the wire connected with post A and the other terminal of the condenser connected with the wire connected with post O.

A wire is next used to connect post P with the No. 2 terminal of rheostat H and the No. 1 terminal of rheostat I.

The No. 1 terminal of rheostat H is then connected with the F_2 terminal of socket F, while the No. 2 terminal of rheostat I is connected with the F_2 terminal of socket K.

The G terminal of transformer C is then connected with the G terminal of socket F, while the F terminal of the transformer is connected with binding post Q.

Next connect the top outside spring of jack G with the P terminal of socket F; the inside spring, which makes contact with this outside spring, with the P terminal of transformer J; the bottom outside spring with binding post R; and the inside spring, which makes contact with the bottom spring, with the B terminal of the transformer.

Final Connections and Batteries

Now connect the G terminal of transformer J with the G terminal of socket K. The F terminal of the transformer is then connected with post S.

The P terminal of socket K is connected with the top outside spring of jack L. The inside spring, which makes contact with the top spring, is connected with binding post M.

The bottom outside spring of the jack is connected with binding post T, while the inside spring, which makes contact with the bottom spring, is connected with binding post N.

The batteries are easily connected. The positive of the A and the positive of the C batteries are connected with binding post O. The negative of the A battery is connected with binding post P. Leads from binding posts R and T are tried on various taps of the B battery, varying from 45 to 90 volts, until best results are obtained. Leads from binding posts Q and S are tried on various negative taps of the C battery until the best values have been obtained.

Although good results can be obtained even though the values of C and B batteries are not absolutely correct, best results are obtained only when these values are just right.

It will pay in the long run to spend some time in trying various combinations until best results are obtained.

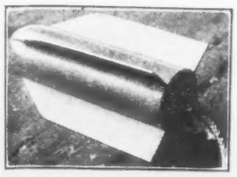
The A battery used will, of course, depend on the type of tubes used. The total value of the B battery used for both the detector and amplifier should not exceed 90 volts. The C battery should have a value of about 7 volts. The tapped portion of a small B battery will usually do very well.

The positive 22½-volt terminal is used as the positive terminal of the battery, while the taps are used as the negative taps.

Hurling Ice Comet Is Novel Sport for Skaters

WHEN this ice comet is swung on the end of a rope and released, it strikes the ice and scoots away in a straight line on two of the fins. It is intended to be aimed at a suitable target, such as a pumpkin. Over smooth ice it will travel several hundred feet at great speed.

Cut the hardwood spindle 7 in. long and 2½ in. in diameter, and taper one end to



The completed ice comet (at left) and method of sawing the fins or runners from sheet steel (below)

a conical point, which can best be done on a lathe. Then grip the wood in a vise and make four saw cuts parallel with the axis ½ in. deep and equally spaced. From 20-gage sheet steel, cut four fins, each 1½ in. wide and 1 in. less in length than the spindle. The front ends are curved on a grinder. Then the long edges are chipped slightly with a chisel and driven into the slots. A large screweye is turned in the back end for fastening the rope.

The wood should be protected from dampness by two coats of shellac, varnish, or paint.—D. V. H.

Dashboard Ammeter Is Useful for Testing Dry Cells

IF YOU have a car equipped with a dash ammeter, you can tell the exact amperage of a dry cell by attaching wires to it and holding their ends against the binding posts of the ammeter, as illustrated.

A cell that registers from 18 to 30 amperes is good. Cells that give only five or 10, while not good enough to connect with new cells, can be connected and used in an emergency. One dead cell, however, will reduce the current in the five good cells to next to nothing.

A VARNISH for wallpaper can be made of 1 part borax, 1 part flake white shellac, and 20 parts alcohol by weight, strained. Two coats will make the paper moderately washable.

Is There Such a Thing As a 100 Percent Perfect Chisel?

THERE IS. We can make 100 percent perfect chisels for cutting lead, concrete, nickel, steel, cast iron or anything else if we know in advance to what use the tool will be put.

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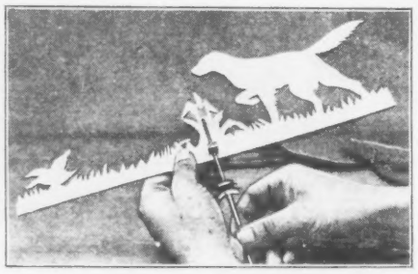
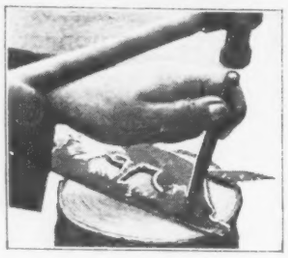
Decorative Weather-Vanes that Tell a Story

By Ernest Bade, Ph.D.

WEATHER-VANES may often tell a story in addition to the direction of the wind. For instance, a hunter might have a flock of geese flying over his house, a sailor, a metal ship upon a metal ocean,





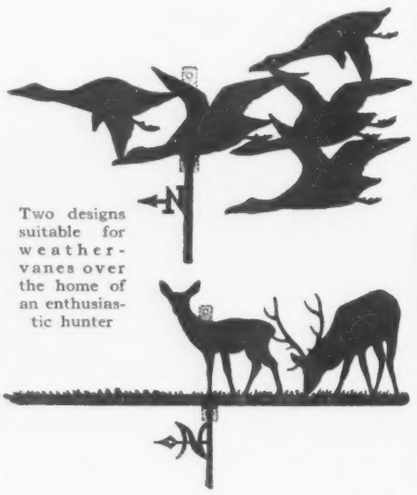
After being cut out with a chisel, the ornamental vane is pivoted on an iron rod so that it will swing freely in the wind

a dog fancier, a dog pointing to the wind, or, as illustrated, a setter flushing a bird.

Such weather-vanes are easily made from thin sheet tin, zinc, or iron. First draw the silhouette of the desired design upon paper and transfer it to the metal to be cut.

Etch it in the metal with any pointed instrument; then, with cold chisel and hammer, gradually cut out the design. Although this sounds like a slow process, the work is comparatively rapid.

Note that two flaps are bent backward at right angles to the design, one at the top and the other at the bottom. Two



Two designs suitable for weather-vanes over the home of an enthusiastic hunter

holes are drilled or punched in these so that the whole will pivot easily on a strong iron rod. The rod is fastened to the roof or some support exposed to the wind.

When the weather-vane has been mounted, it is advisable to clamp another piece of metal around the rod to represent an arrow and the letter N. This part

(*Continued on page 113*)

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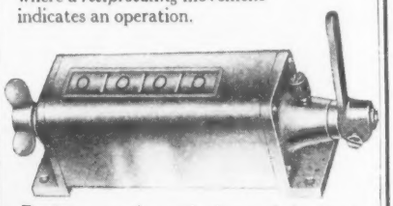

Registers one for each throw of the lever and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $11.50—subject to discount. (*Cut less than ½ size.*) Set-back *Revolution* Counter of similar model, $10.00 (list).

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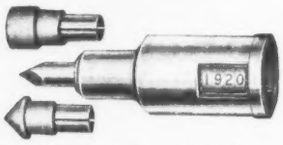

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The Veeder Mfg. Co.,
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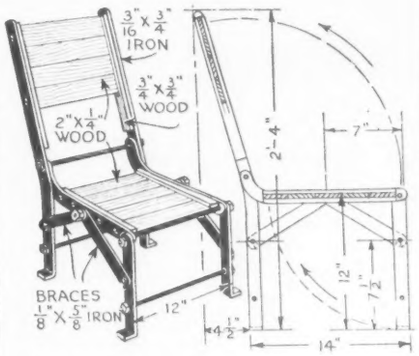
Mak[illegible] Decorative Vanes

(*[illegible]inued from page 112*)

need only be small, one eighth of the entire length of the vane being sufficient. It should be so attached to the rod that the arrow points toward the north.

Strong Folding Chair Made with Framework of Band Iron

ON AUTO and camping trips, I find useful the collapsible chair illustrated. Although it weighs only 5 lbs., it will sustain about 300 lbs. and is sturdy enough to stand the abuse that so often completely wrecks camping chairs. The



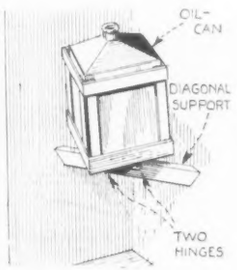
The completed chair and sectional view showing dimensions and method of folding

details of construction are made clear in the illustration.

The tie rods are ¼ in. in diameter. The braces between the seat and the legs are pivoted to the seat frame by means of ¼ by ¾ in. cap screws, riveted for a loose fit. The back and seat are made of ¼ by 2 in. slats fastened to ¾-in. strips on each side. The arrows show how the seat folds.

Tilting Shelf for Oilcan

A CONVENIENT rack for oil containers can be made by fastening the can crate on a diagonal piece in the corner of the garage, thus keeping it out of the way and facilitating pouring the oil.



To pour oil, the can is swung forward

The crate bottom is hinged to the crosspiece so that the center of the can will be situated nearer the corner. This will cause the can to rest against the wall when not in use and yet allow it to be tipped forward with one hand, while the other holds the measure. If a crate is not available, one can be made to fit the can.

WHEN the pivot bolt of an iron pump or the pins of a door hinge become loose, it is advisable to try giving them a half turn. This will usually take out some, if not most, of the play.—L. M.

This handy vise, with swivel base, can be adjusted at any angle for any kind of work—"Bull Dog" Jaws—for 'all-around' use.

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HERE'S just the tool you need for your work bench during winter months—a Prentiss Vise. All those little jobs you have been planning to do will be easier when you have this handy tool. Its strong jaws, deeply serrated, will hold objects of any shape, or size.

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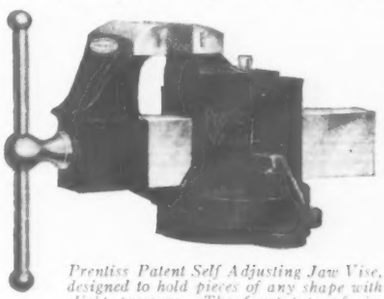

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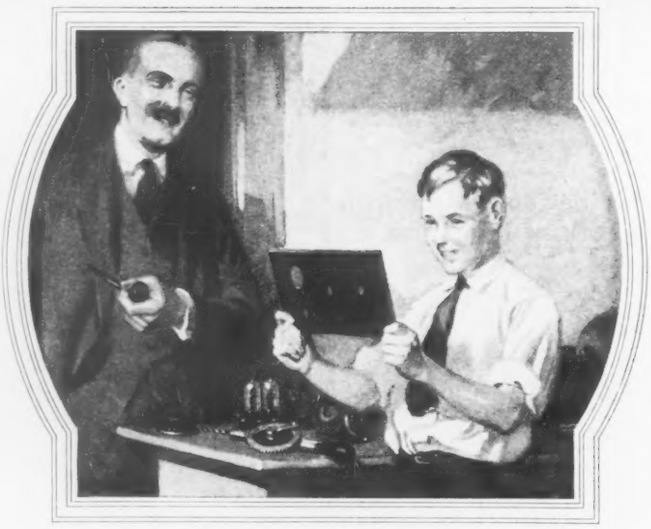

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4—7 x 14 x 3/16	8—12 x 18 x 3/16
	9—7 x 26 x 3/16

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Unique Plant Stand Has Trellis Support for Bird Cage

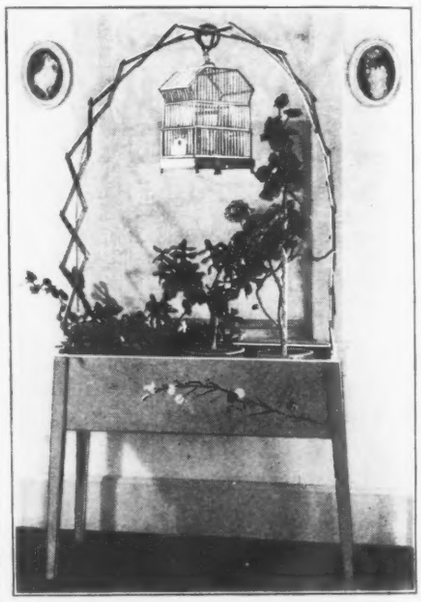
By Stacy E. Matthews

ONE of the pieces in a dining-room set I recently built for my home is the three-in-one plant stand illustrated. It is distinguished from the average flower box by the trellis work and hanging bird cage, and yet, with all its novelty, it is not difficult or expensive to construct.

The materials, which cost me about $3, are as follows:

1 pc. 1½ by 10 in. by 29 in. white pine, clear
1 pc. ⅞ by 9½ in. by 8 ft. white pine, seconds
1 pc. ⅞ by 12 in. by 3 ft. 1 in. white pine, seconds
1 pc. ¾ in. by 10 ft. 2 in. band iron
47 lineal ft. ⅛ by ⅞ in. redwood strips
8 lineal ft. ½ by ½ in. strips, any wood
4 ¼ by 1½ in. carriage bolts
20 3/16 by ⅞ in. stove bolts
1 pt. paint any color desired

First rip the four posts 1½ by 1⅝ by 29 in. and dress them to 1½ in. square.



Much as it differs from the conventional plant stand, this attractive piece of furniture is easily and cheaply made

Lay them off in pairs to be plowed—½ by ½ in.—for the sides and ends. After plowing, taper the posts on the inside edges only from the bottom of the plowed groove to 1 by 1 in. square at the lower ends. Next, cut the two side panels, 9½ in. wide, 36 in. long at the bottom, and 35 in. long at the top, and the two ends, which are 9½ by 12 in. The bottom, ⅞ by 12 by 36 in., must be cut out for the posts at each corner and fitted in from underneath. Then the ½ by ½ in. strips are fastened with finishing nails to hold up the bottom.

The foundation for the lattice-work is the strip of band iron. Beginning near each end, drill a series of 3/16 in. equally spaced holes about 7 in. apart. Then after fastening one end in the box, gradually spring the other until it is arch shaped and bolt the second end in place. Next bolt a pair of ⅛ by ⅞ by 14 in. redwood, cedar, or cypress strips to each of the remaining holes in the band iron. The first pairs of strips will probably have to be specially fitted in the box. The outside ends of the strips are finally bolted together to form a diamond design. The

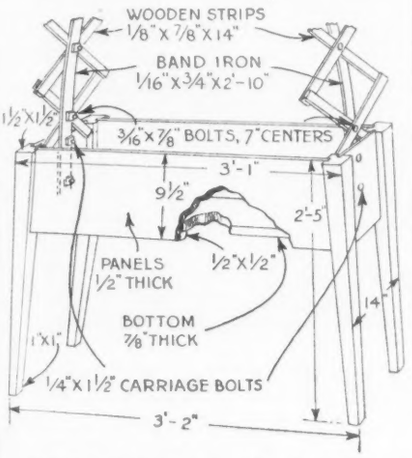
(*Continued on page 115*)

Unique Plant Stand

(*Continued from page 114*)

spring for the bird cage is fastened to the central point of the lattice-work.

Several coats of paint should be given and for best results the last coat should



Details and dimensions of the flower box and trellis, which cost about $3

be well rubbed with pumice-stone and oil. The floral spray is a painted motive that appears on the buffet, serving-table, china closet, and tea wagon of the dining-room set. A central stenciled ornament and plain line border would perhaps be more effective for general use.

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to provide, upon request, information relative to tools, material, or equipment.

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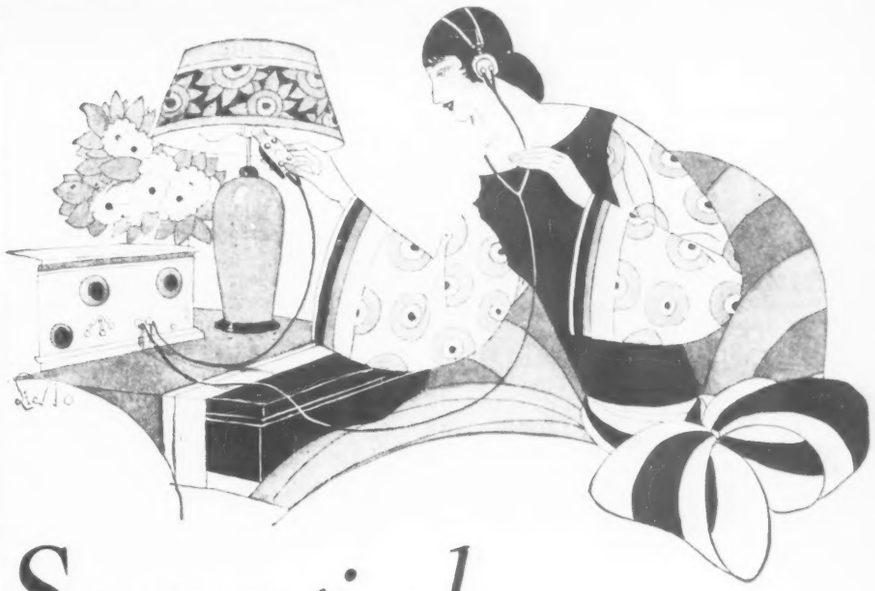

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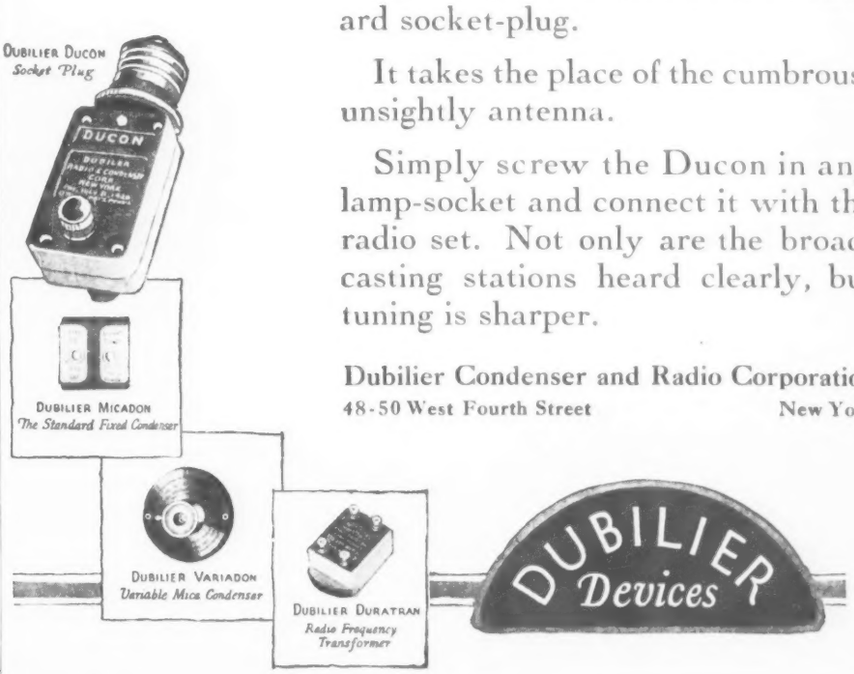

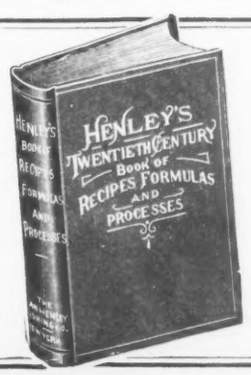

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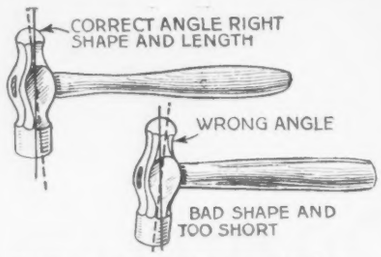
A Golden Rule Insures Your Success with Tools

DO UNTO your tools as you would have done unto you, if you were a tool. This is the golden rule as applied to tools. It also can be applied with good effect in the Chinese or negative form, "do not unto others," and so on. Proper cleaning and lubrication, together with correct sharpening and repairing, always pay.

One of the most important tools used in the home or shop is the hammer. How



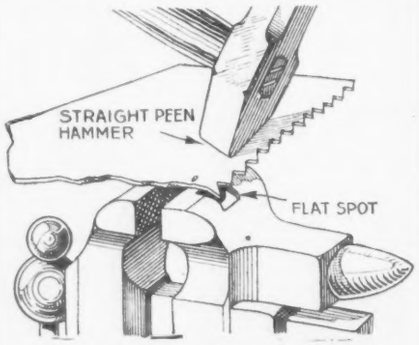
Handles must be fitted to hammer heads at a slight angle, as shown, somewhat exaggerated in the upper drawing

does our rule apply to the hammer? Well, use it as it should be used, always hitting with the head and never the side. Keep a good strong handle in the hammer, and never use a hammer with a cracked handle.

The handle should be of the proper shape and length. To have a hammer in perfect balance, insert the handle so that the central axis through the head stands at a slight angle to the vertical axis of the handle, with the driving head a trifle low. If a handle is inserted in a reverse fashion, with the head standing high, it will be awkward to use and handle. This is illustrated somewhat exaggeratedly for the sake of clearness.

If a hammer face chips, have it annealed slightly. A hammer that chips is dangerous to use, and if the chips are large and deep, discard the hammer altogether.

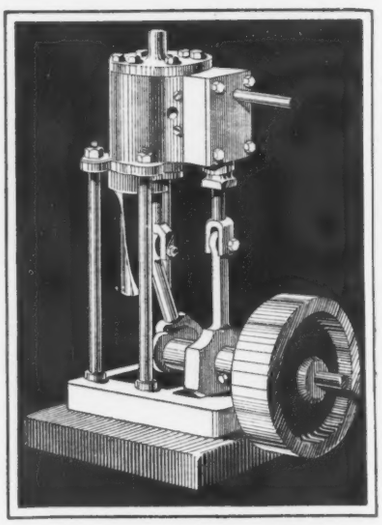
Many a weary back and arm can be spared if the saws are kept well set and sharp. Lack of a saw set is no excuse for not setting the teeth of an otherwise good



Using a flat spot on the rear vise jaw as an anvil for setting the teeth of a dull saw

saw, because the top of your vise will serve as a place to set your saw. On the rear jaw, where the straight, flat surface verges into the radius of the rear sloping surface, file a small flat, as illustrated. This flat should be at an angle of from 5 to 7 degrees. Lay the saw on the vise jaws

(*Continued on page 117*)



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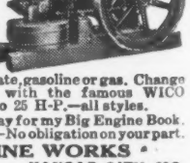

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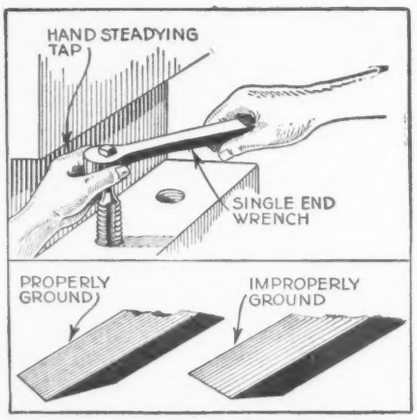
Golden Rule Insures Success

(*Continued from page 116*)

and with a straight peen hammer, peen each alternate tooth to the bevel of the filed spot. Turn the saw around and repeat the process on the remaining straight teeth. If carried out carefully, this little trick will enable one to make a good job of setting saws, although it is easier for an amateur to use a regular saw set if one is available.

Before jamming your saw through an old piece of lumber, look the piece over to see whether there are any nails or screws hidden beneath the surface. If you do hit a nail, stop immediately, to save the saw teeth. Turn the piece around and saw the remaining distance nearly through from the other side.

Keep your plane irons sharp, and when grinding them do not try to hurry the job by robbing them of clearance. An iron to be ground properly must have a fairly long, thin edge. A hurried job will result in a blunt, thick edge, which will not cut freely. If a plane blade is nicked by coming in contact with metal, it will leave a raised line on the finished work, and therefore should be reground at once.



Using single-end wrench when tapping in a tight place and sharpening planes and chisels

Chisels should be ground like plane irons. They should never be used to open tin boxes, scrape off paint, and other jobs that dull the cutting edge.

When a bit hits a nail or screw, one or more of its three main parts are affected: The lips are burred, the cutting edges dulled, or the center feed screw ruined. While it is possible at times to fix up a ruined bit with a file, it usually will not function as it should. Use caution and examine the wood carefully before sinking a bit into it.

When drilling the harder metals, such as steel and cast iron, stop immediately when the drill starts to squeak or smoke excessively. If one persists in forcing a smoking and squeaking drill through a hard piece of metal, the result will be a burnt-up drill.

At the first sign of a drill's becoming dull, remove and resharpen it; then reduce the speed of the drill press and jack up the feed. This is done to get under the glazed surface at the bottom of the drilled hole; that done, the remainder of the hole can be finished as usual.

When cutting scale either on cast iron

(*Continued on page 118*)

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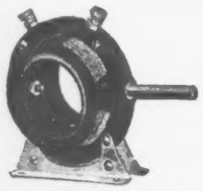

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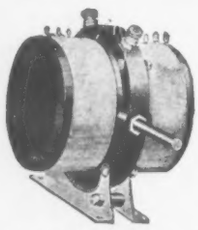

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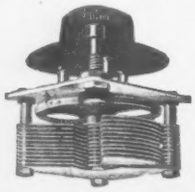

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Golden Rule Insures Success

(*Continued from page 117*)

or steel, always remember to use a slow speed and a heavy feed. Water makes an ideal lubricant for cast iron scale, while kerosene is used on steel castings.

When trying to tap a drilled hole in a cramped place, it is often necessary to use a single-end wrench. This invariably causes trouble, as the one-sided pull makes it hard to tap straight and the tap is apt to break. To overcome these difficulties, pull the wrench with one hand and brace the tap with the other hand in a reverse direction to the pull of the wrench.

A slightly rounded chisel edge (for metal) will not break as quickly as if straight across. The straight-ground chisel, if not held squarely, will receive the full force of the blow at one spot, while the rounded point will center itself.

Never use oil out of an old tramp oilcan for oiling a piece of machinery. Rather throw out the old oil, rinse the can with kerosene, and refill with fresh oil.

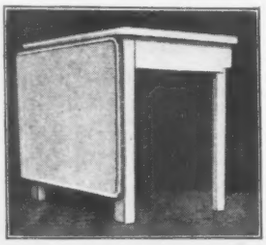
Keep all of your tools clean and well oiled to prevent rust and deterioration. It is always a pleasure to reach for and use well kept and perfectly conditioned tools.—JOE V. ROMIG.

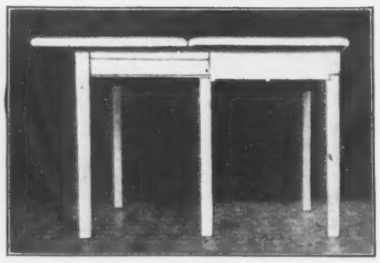
Tilting Porcelain Top Doubles Size of Kitchen Table

MY KITCHEN table can be extended when necessary to seat six or eight persons, and yet ordinarily it takes up no more room and is just as convenient as any other kitchen table.

The extension is an extra porcelain top, obtainable in any ordinary size at department stores. It is fastened to the back of the table with two loose pin hinges and can be removed entirely by taking out the pins. When in a raised position, this top is supported, as shown, by extra legs and side rails that slide out from underneath the table proper. — GEORGE DRASCHE, Long Island City, N. Y.

The table with the extension porcelain top down (at right), and with the top raised and supported by legs that slide out from under the table proper (below)





REMODELING old furniture is a profitable pastime. Captain E. A. McCann will tell what he has accomplished in an interesting article next month.

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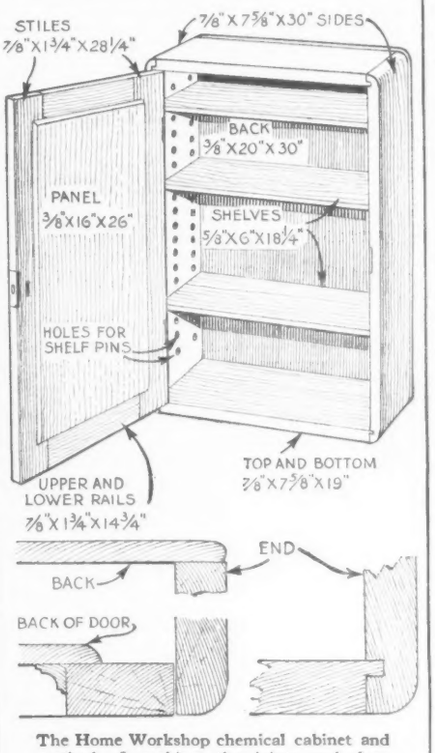
Cabinet Holds Home Workshop Stains and Chemicals

IN RESPONSE to the requests of readers, this cabinet has been designed to hold the stains, colors, and other chemicals required in the average home workshop. A list of the essential chemicals was given in the first of the Home Workshop chemistry series in September, 1923. There is room for these and a number of extra chemicals in the cabinet, as well as space for small scales, spoons and jars.

The cabinet may be constructed of any close-grained wood such as birch or whitewood if it is to be enameled, or any suitable wood if it is to be stained or painted.

Make the joints neatly. Bore two rows of holes for the shelf supports in the end



The Home Workshop chemical cabinet and method of making the joints and door

pieces 1½ in. apart, beginning about 6 in. from the bottom and ending 4 in. from the top. Round the edges, as shown, to a perfect quarter round, after the parts have been nailed and glued together. Bead or round the edges of the back and, after squaring the case, nail on the back.

The door frame may be doweled or nailed together with 3-in. finishing nails. The edges of the back of the door are rounded and the back is fastened in place with brads after the door frame has been squared. A panel molding improves the appearance of the door, but is not essential.

Two plain boxes with fronts 4 by 6 in. and two with fronts 5 by 6 in., all not more than 5½ in. deep, may be made to form small bins for the bottom compartment. The cabinet may be hung with the long edges horizontal, if preferred, provided chains are used to hold the door when open; the back of the door then serves as a sort of worktable.

Beside the material indicated in the illustration, a dozen shelf pins, a lock, and hinges are required.

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FOR two years we've been perfecting a smooth-working, sturdy and handsome Spiral Ratchet Screw Driver. It has stood up under every test.

No. 61 will meet all your screw driver requirements and do it in a better way. The last word in screw drivers—ask to see it in your own hardware dealer's.

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Works three ways; locks tight in position; spiral action for driving or withdrawing screws; right or left hand ratchet action, extended or closed; rigid screw driver, extended or closed. Markings on sleeve indicate each action.

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Spiral or rod, steel, accurately machined; Spiral nuts, manganese bronze; Ratchet Pawls, tool steel, hardened; Handle, stained hardwood; Blades (3), special steel, each blade individually tested; Locking device, absolutely rigid in action; Length, extended, bit inserted—20½ inches.

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SINCE 1868

Kind words from a smoker in far Australia

A more modest manufacturer might not print this letter.

Nevertheless, when an enthusiastic pipe-smoker thousands of miles away takes his pen in hand to say something nice about Edgeworth, a breach of modesty on the manufacturer's part should be forgiven.

"Chetwynd," Copeland Road,
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Australia

Larus & Brother Co.,
Richmond, Virginia, U. S. A.

Gentlemen:

Perhaps you are somewhat surprised to receive this letter from Australia, often referred to in England, our Mother Country, as "Down Under."

I have noticed in some of your American magazines that I subscribe to, testimony in praise of your splendid tobacco. It has occurred to me that, as one of the many smokers of the Edgeworth in this Southern Continent of Australia, I can also add my testimony and appreciation of your world-wide-known and excellent tobacco.

It must be over twenty years since I first tried your "Edgeworth Extra High Grade Plug Slice."

My tobacconist, one of the leading tobacconists of Sydney, had a trial consignment of the Edgeworth to test the taste of his customers.

Just at that time I was smoking several kinds of high-grade imported tobaccos, but somehow I could not get any of them that exactly pleased my taste. Some brands were excellent for a while, and then deteriorated.

But from the first purchase of your Edgeworth I have found it absolutely of the one uniform standard, without any change during the whole twenty-odd years I have been smoking it. I have been so satisfied with it that I have never purchased any other make.

I have induced a great number of my friends and fellow officers to try Edgeworth, and most of them have the same high opinion of it that I have.

My wish is that your company may prosper and continue to manufacture the renowned Edgeworth, and that I and my fellow smokers of this "Fair Australia" may be spared to a good, ripe old age to enjoy your fragrant weed.

Yours sincerely,
(Signed) Thos. Skellett

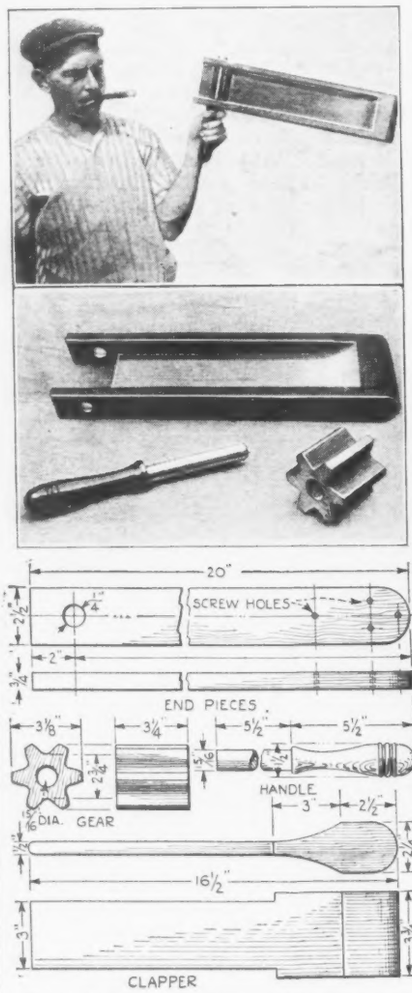
For free samples of Edgeworth—generous helpings of both Edgeworth Plug Slice and Ready-Rubbed—send a postcard with your name and address to Larus & Brother Company, 59 South 21st Street, Richmond, Va.

If you will also include the name and address of your regular "tobacconist," your courtesy will be appreciated.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Ready-Rubbed for the same price you would pay the jobber.

Giant Noise-Making Rattle Can Be Heard a Mile

FOR any festive occasions when the average boy deems a large amount of noise absolutely necessary, this giant noise-maker will be found infinitely safer than revolvers, toy cannons, and other dangerous explosive devices. It can be heard easily a mile away, yet any boy can make it with the simplest tools.



The rattle assembled and disassembled, and details showing how the five wooden parts are shaped

Oak is perhaps the best wood to use for durability and loudness. The shape and sizes of the five parts are made clear in the illustrations.—JOHN H. SCHALEK, Pittsburgh, Pa.

Getting Rid of Old Glue

IN REGLUING joints that have been previously glued, a good job cannot be done unless the old, hardened glue is removed entirely. In many cases it is extremely difficult to scrape off the glue. For instance, a piece often is split so that the surface presents an intricate series of ridges and hollows, which must fit together accurately. To clean off the glue on such a joint use a stiff brush—an old nail-brush will do—and hot water. This will do the work effectively and leave the surface in the best possible condition for re-joining. Allow the wood to become thoroughly dry before making new joint.

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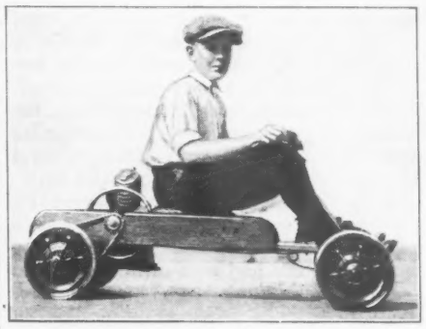
Toy Coaster Wagon Is Motorized for Nine Dollars

NINE dollars was all it cost to turn a toy coaster wagon into the "automobile" illustrated. The gasoline engine, which had once driven a washing machine, was bought at a second-hand store for five dollars; the coil, from an old Ford, cost only a trifle, and the battery, at three dollars, was one of the heaviest expenditures.

The engine is attached to the bottom of the bed near the rear end of the coaster.



A gasoline engine from an old washing machine propels the coaster smoothly on paved roads

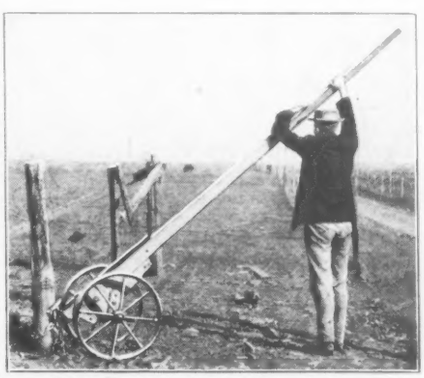
It drives one of the rear wheels by means of cog wheels and a chain taken from an old bicycle.

The handlebars and post of the same broken-down bicycle serve as the steering gear, the prongs at the bottom of the post being spread and bolted to the front axle. The steering, however, is done mainly with the feet.

While the power is not sufficient to pull the coaster on dirt or rough roads, the machine runs well on sidewalks and paved streets.—B. F. CLARK, Hutchinson, Kan.

One Man Raises Old Fence Posts with Powerful Puller

A FARMER in Tippecanoe County, Ind., uses the homemade puller illustrated for raising posts. The discarded wooden tongue is mounted on two old binder truck wheels and a hook and chain



Made of odds and ends, this puller saves the time and labor of digging posts

are fastened to the lower end so that the chain can be fastened around the post. By throwing his weight on the other end of the pole, the farmer pulls up the post faster and easier than it could be dug out by hand.—J. C. ALLEN, West Lafayette, Ind.

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MENTHOL COUGH DROPS
GIVE QUICK RELIEF

$25.00 in Prizes

See top of page 6 in front of book for details

Sewing Cabinets Built at Home

(*Continued from page 81*)

indicated. The posts are 1⅜ by 1⅜ by 25¼ in., plowed to take the plywood end panels, which are ¼ by 10½ by 18 in., and the back panel, which is ¼ by 12½ by 18 in. The top drawer front is ¾ by 3½ by 11¾ in.; the center drawer front, ¾ by 2 by 11¾ in., and the bin front ¾ by 10 by 11¾ in. The drop leaf is supported by an ornamental iron bracket or a hinged wooden bracket.

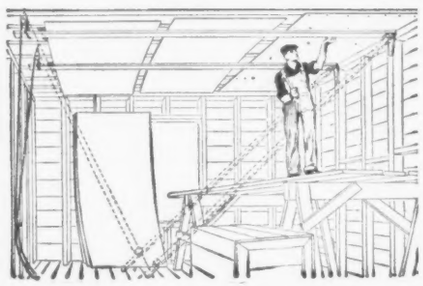
In finishing either cabinet, the wood should be stained, filled, and given several coats of thin white or orange shellac, each rubbed with pumice-stone and crude or raw linseed oil. Several coats of good furniture wax can then be applied, if desired. For a varnished finish, stain and fill the wood and give one coat of white shellac and two or three coats of varnish, rubbing the last coat with pumice-stone and oil.

Both the cabinets were designed by George F. Kaercher especially for POPULAR SCIENCE MONTHLY. The complete working details and bills of materials are contained on a single large blueprint (No. 31), which can be obtained by sending 25 cents to the Blueprint Service Department, POPULAR SCIENCE MONTHLY, 225 West 39th St., New York.

How to Cover a Ceiling with Wallboard Single-Handed

ANY one who has attempted to cover a ceiling with wallboard, especially with large sheets of heavy gypsum board, knows how difficult it is, even with a helper or two.

I have overcome the usual difficulties, however, by the simple expedient illustrated. Take two boards about 6 in. wide and as long as the room is wide. Hinge one end of each board to the plate or studding, spacing the boards apart about one third the length of a sheet of wallboard, and below the ceiling, the thickness



The sheets of wallboard are hoisted to the ceiling on two long, hinged boards

of the wallboard. Nail a cleat on each board about 3 ft. from the free end.

A rope is tied around the free end of each board about 2 ft. from the end of the board and passed over pulleys attached to the joists or rafters above.

The wallboard sheets are then placed on the two boards and drawn up to the ceiling. The loose ends of the rope are tied to spikes driven in the studs. It is then comparatively easy to shift the wallboard sheets into position and nail them.

A piece of flooring as long as the room is high, with a short piece nailed on the end in the form of a T, is a help in shifting the sheets.—M. VANSLYKE, Jacksonville, Fla.

Earl Roberts, tenor-banjo artist with the famous Westphal Orchestra, Columbia record artists, uses and endorses the New Gibson Mastertone Banjo.

You, Too, Will Appreciate the New Gibson Mastertone

The same qualities of this tenor-banjo which have captured artists in the great recording orchestras will win you, whether you take up the banjo for pleasure alone, or for the wonderful opportunities for profit which it affords.

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FREE BOOK. Send for your copy and details of Easy Payment Plan on any Gibson instrument, including Tenor-Banjo, Mandolin-Banjo, Guitar-Banjo, Cello-Banjo, Mandolin, Mandola, Mando-Cello, Guitar, Harp-Guitar and Mando-Bass. Mention instrument when writing.

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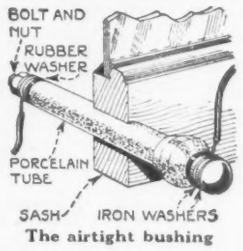
KUEMPEL CO., 526 Kuempel Bldg., Guttenberg, Iowa

Improving a Porcelain Bushing Used for an Aerial Lead-In

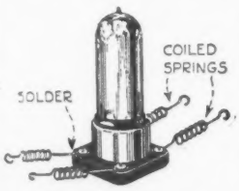
THE porcelain tube ordinarily used as a bushing for insulating the radio lead-in where it enters through a windowsash, frame, or window board, can be improved greatly by running a threaded copper rod or ordinary bolt through it, as shown. Rubber and iron washers at each end make the tube practically airtight and no cold air or rain can come in around the wire.—IRWIN E. WALTON, Bantry, N. D.



The airtight bushing

Spring Suspension Protects Vacuum Tubes from Jars

FOR mounting radio vacuum tubes flexibly, the most practical scheme I have found is that illustrated. Four brass springs are wound from spring wire, obtainable at hardware stores for about 10 cents a spool. The ends of the springs are soldered to the four terminals of the socket, and in this way they provide connections and shock absorbers at the same time.

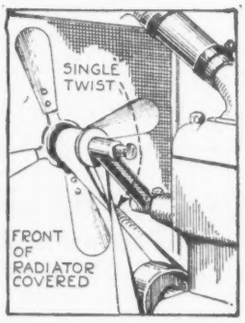


The springs serve as connecting wires

This method of tube insurance is well worth the trouble, especially in portable sets. It should be remembered, too, that a vacuum tube, after being used to some extent, should not be placed in a portable set without first protecting it in some such way, since the filament becomes brittle.—CARTER FISKE, New York.

Thawing Frozen Auto Radiator with Engine Heat

A FROZEN radiator often can be thawed out in an emergency by reversing the fan and blowing the hot air surrounding the engine through the radiator framework. Loosen the nut that holds the fan arm in position and lower this arm sufficiently to allow the belt to be crossed. Then raise the arm until the belt is tight on its pulleys and fasten it in place. When the engine is running, the hot air will be blown against the radiator cells and any ice will soon be melted.



THE soldering iron is a useful home tool. In next month's Home Workshop, Henry S. Laraby tells how to solder and Dr. E. Bade discusses solders and fluxes.

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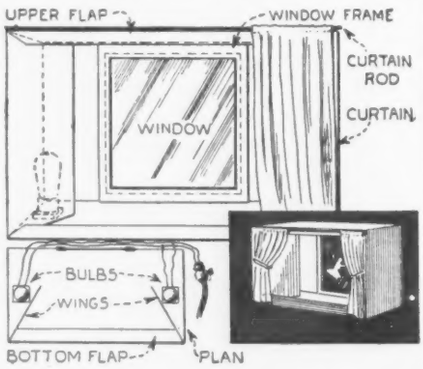
Cardboard Carton Forms Simplest Toy Stage

By H. S. Trecartin

AT DIFFERENT times I have made two "picture theaters," as the children call them. These seem to give them more lasting pleasure than do most of their toys. Children love to cut out the colorful and often really beautiful pictures from magazine covers and advertisements, and for such prints this "theater" furnishes an attractive setting.

Most of the materials can be had for the asking, and whatever has to be bought will not cost more than 30 or 40 cents. The whole job can be done in an hour's time with a knife and a screwdriver.

The stage is made of a strawboard carton or packing box. The flaps on one side are turned in at an angle to form the



Children enjoy displaying colored pictures cut from magazines in this easily made theater

wings, and an opening in the other side is cut to fit a piece of window glass.

Electric lamps, placed behind the wings, are hidden from the audience, but throw their light on the pictures, which are placed against the window from the back of the box. Cloth curtains are drawn to hide the change of pictures, and a switch operated from the back turns the lights on and off. The children immensely enjoy operating these simple details.

After the box flaps are glued together, the opening for the window may be cut to accommodate any small piece of glass at hand, about 6 by 8 in. or 8 by 10 in. The glass is fastened in the opening by strips of heavy paper.

Finishing Off the Corners

The narrower flaps at the front of the stage are pushed in and fastened at an angle of about 45 degrees. The top and bottom flaps are cut down to about 3 in. in width and the corners are clipped off so that they can be turned in at an angle.

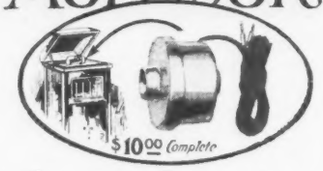
These flaps can be secured by gluing with heavy paper, by fastening with thread and needle, or by tacking to small pieces of wood cut at the correct angles.

The stage may be decorated by pasting colored paper or wallpaper over it, or by painting it with oil or water colors. A cloth curtain should be provided; it may roll up on a rod or, better, be pulled each way from the center by two strings, carried around to the back.

Two cheap porcelain lamp sockets are

(*Continued on page 125*)

Morrison



Loud Speaker

Enthusiastic

—is the only word that describes those radio critics who have chosen Morrison Loud Speaker. For them Radio has taken on new delights. Bright stars of the musical comedy stage, famous lecturers and singers all are theirs no matter where they live—every night as long as they care to stay awake.

Real reproduction without annoying vibrations as soft or loud as you please—that describes Morrison attached to your phonograph tone arm or used with a horn.

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That's all Morrison costs complete with 5 foot cord Nickel Plated Model

This perfect little loud speaker has no rivals. We assure you your money back if you don't like it.

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A Most Efficient Tool
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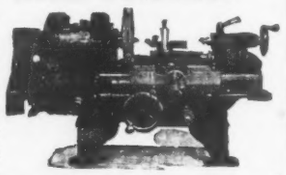

The MONARCH Jr. Lathe is the ideal machine tool for the home workshop, repair shop and garage. Turns out, with 1000th-inch accuracy, small wood and metal parts. *Experimenters, inventors, mechanics* are enthusiastic over it. Completely equipped; auto-safety devices; semi-quick change gear. Priced within your means.

$245 9 inch Lathe—2½ ft. Bed—With Bench Legs

Also Built with bed lengths up to 5 feet. Made in 11-inch swing size too, at slightly higher price.

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The Pony Bench Machine shown here combines six machines in one: Saw, sander, drill, grinder, polisher and buffer. It saws 1½-inch stock with ease, and does mitering, dadoing tenoning, etc. Easily driven by ¼-hp. or 1/3-hp. motor. Used in thousands of shops, both industrial and private.

Boice-Built Bench Machines include larger Saws, Band Saws, Lathes, Drills, Jointers, and Motors. Write today for completely descriptive circular on any of these machines.

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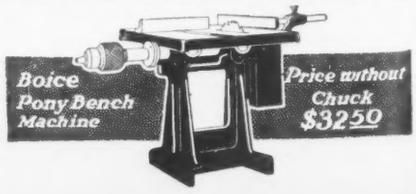

The Opinion of 1,000 Others

To find out what influences ambitious men and women to enroll with the American School, an advertising agency sent out a questionnaire to one thousand names, taken at random from our student rolls. The answers to three of these questions show very clearly how our School is regarded by our students, both before and after enrolling.

Why Students Inquired About Our Courses

31.5% wrote only to the American School, because our advertisements impressed them more favorably than the advertisements of other home study schools.
27.0% had heard of the American School before.
23.7% answered several home study school advertisements, so they could select the best.
15.1% were recommended to our school by a friend or acquaintance who had taken one of our courses.
2.7% inquired for various other reasons.

Why Students Considered Taking a Course With Us

37.4% wanted to qualify for better positions.
22.5% wanted assistance in their present work.
20.7% wantcd more information on the subject for which they enrolled.
11.2% wanted to prepare for college entrance examinations.
7.4% wanted to "brush up" on subjects previously studied.
.8% enrolled for various other purposes.

What Students Really Think About Our Courses

97.2% say our courses are "Good."
1.4% say our courses are only "Fair."
1.4% say our courses are "Not what they expected."

When you take the average opinion of 1,000 people, selected at random, about some one thing, you will get a definite idea as to the worth of the thing. The average opinion of these 1,000 people is that our courses are O. K. Do you need further proof? If you want to get ahead and are considering a course of practical training, you will find that the American School is the best place to get that training. From us you will get the best grade of training at the lowest cost. And further—

Our Money-Back Guarantee Protects You

You cannot lose when you enroll with us. If after you have finished your course you are not absolutely satisfied, if you do not believe that the training we gave you will help you to get ahead, just write us and we will refund to you every cent you paid us. Mark the coupon. Your request for information puts you under no obligation and no AGENTS WILL BOTHER YOU.

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..Business Manager	..Foremanship
..Financial Manager	..Sanitary Engineer
..Sales Manager	..Surveyor (& Mapping)
..Cert. Pub. Accountant	..Telephone Engineer
..Accountant & Auditor	..Telegraph Engineer
..Bookkeeper	..High School
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..Electrical Engineer	..Wireless-Radio
..General Education	..Business Law
..Personal Analysis	..Undecided

Name.....
Address.....
Occupation.....

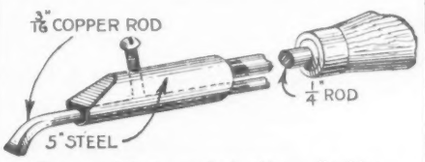
Cardboard Carton Forms Stage

(*Continued from page 124*)

set behind the wings and connected with lamp cord carried through holes punched in the box to a socket switch. A drop cord from any house-lighting socket can be connected with this, if electricity is available. It will be just as easy, however, to connect up small dry-cell lamps and then the batteries also may be placed inside the stage.

Radio Soldering Copper Reaches Easily into Tight Corners

HOW to solder connections in awkward corners is a problem that frequently confronts the radio fan who builds his own sets. It is a great aid in such cases to have a soldering copper made as shown



Because of the heavy body this small soldering copper retains its heat for some time

by inserting a copper wire or rod into a steel, iron, or copper body about ¾ in. in diameter and from 3 to 5 in. long. A handle of any convenient length is then fitted to this head. The bulky part of the head retains enough heat to keep the point warm for a considerable time.—J. D.

Connecting an Extension Cord with Your Radio Phones

THE broadcast listener often wishes to share his headset, but finds it inconvenient because of the shortness of the cord between the two receivers. This is overcome without rewiring the phones by using two extensions preferably made of silk-covered wire of flexible tinsel.

The original cord is cut about 5 in. from one of the receivers, the cuts not being made exactly opposite each other. To

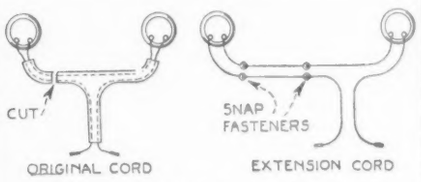
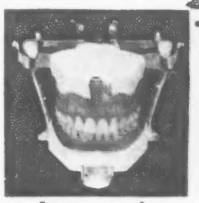


Diagram showing how the telephone cord is cut and two long extensions are inserted

each of the four wire ends thus produced is soldered one part of a large size snap fastener. The interlocking parts of the fasteners are soldered to the ends of two 10-ft. lengths of the new single cord, which can be purchased by the foot.

One must be careful not to mix up the connections. Usually a cord with marked insulation runs between the receivers, connecting them in a series, while a plain insulation is used on the cord from each receiver to the terminals. The new cords can be neatly sewed together in places with green silk thread to match the insulation.—KARL L. MARTIN, Cleveland, Ohio.

Dental Laboratory EXPERTS WANTED



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Stock Sizes

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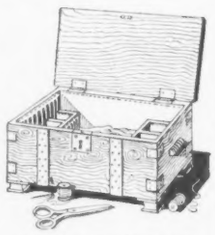
6 x 10½	7 x 24
6 x 14	7 x 48
6 x 21	9 x 14
7 x 9	10 x 12
7 x 10	12 x 14
7 x 12	12 x 21
7 x 14	14 x 18
7 x 18	20 x 24

Look for this stamp on every genuine RADION Panel. Beware of substitutes and imitations.

American Hard Rubber Co.
11 Mercer St. New York

Miniature Cedar Chest Sewing Boxes Find Ready Sale



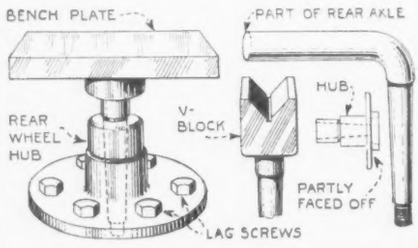
A cedar sewing box

WHILE confined to the house with rheumatism, I made use of my spare time in building miniature cedar chest sewing boxes from pieces of Tennessee cedar left over from large chests. They were made exactly like large chests, but lined with silk and with small pockets in the ends for spools and ribbons and were finished in the natural color with varnish. Being more or less of a novelty and very attractive, they sold at a good price, so that I dispose of all I can make.—EARL FORD, Bangor, Me.

Old Auto Hub Serves as Useful Bench Fixture

WORN out and discarded auto parts often can be worked up into serviceable tools for the home workshop. A handy fixture of this kind is illustrated.

A rear wheel hub from a smashed wheel is obtained and the side carrying the hub cap is faced off flush with the surface of the flange. This leaves the main part of the hub with a tapered bore, into which



A rear wheel hub forms swivel mounting for bench plate, V-block, and riveting anvil

fits the tapered end of the axle. The hub is screwed to the workbench.

Tools such as a bench plate, a V block, a bent riveting anvil and the like, each fitted with a rear axle shank, can be placed readily and quickly in the socket and revolved into the most convenient position. As the threaded end of each tool shank projects through the bore of the hub, an upward tap with a hammer will knock it out.

The castings for the bench plate and the V block are bored for a press fit over the turned end of the axle.

Refinishing an Old Table

AS I was passing a furniture store recently, I saw a black drop-leaf table, with clusters of flowers painted on the leaves. This gave me the idea of removing the dingy finish from an old gateleg table of my own and painting it with Japan black, a flat color. I then cut pictures of flowers from a magazine and pasted them on the center of the table and on the leaves. The table was given three coats of varnish, the last coat being rubbed down with pumice-stone and water.

Sell
your snapshots

You can make your camera self-supporting by selling your pictures to "Popular Science." Mr. J. G. Pratt, of Washington, D. C., tells in a recent issue of *The Camera*, how he has made his camera pay for its upkeep. This is what Mr. Pratt says:

"Every red-blood American finds himself at times in some little difficulty which he overcomes by the inventiveness of his own brain. These ideas are worth money, and if you will but take a photograph or make a sketch of the thing in hand and send it to the right publishers, you will not only have the satisfaction of having overcome the difficulty, but more often than not will receive a fair size check for your trouble.

"For instance, the motormeter on my car insisted on wearing out the fiber washer, so that if screwed down tight, it would point forward instead of crossways. This I corrected by drilling a small hole in the lower flange, threading it and inserting a set screw. It worked fine, and I not only had the satisfaction of eliminating an unpleasant imperfection in the car, but a photograph of it brought me a check from Popular Science."

Popular Science Monthly is always ready to buy live photographs at good prices from amateur photographers. These need not necessarily concern the results of your own ingenuity. The shops and factories in your town, the hardware, automobile accessory, radio and department stores are constantly showing new mechanical devices that would be of interest to Popular Science readers. Your neighbors are rigging up ingenious homemade appliances to aid them in painting their houses, operating their cars or radio sets. Good photographs of things of this sort, taken to show the operation of the devices in human hands, are always in demand by Popular Science Monthly.

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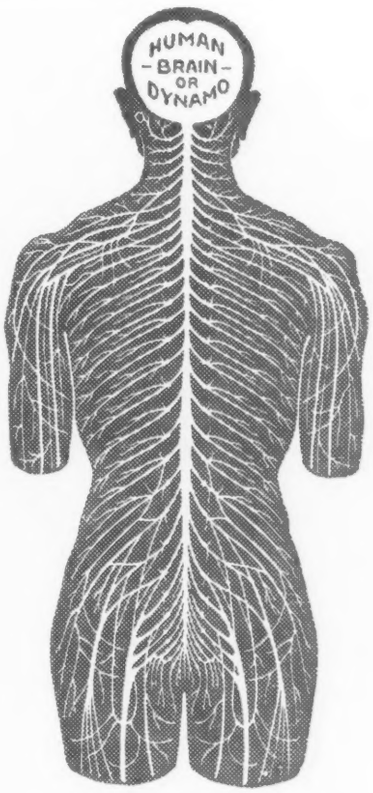
What Do Chiropractors Mean by Innate Intelligence?

THE temperature of a normal human body is approximately 98.6 degrees. You may sit in a room the temperature of which is 80 degrees, or go out of doors when the thermometer registers zero and your temperature, if you are in health, will not vary a single degree, because, resident in your body is an intelligence that generates, distributes and regulates the heat of the body, and instantly adapts it to the change in temperature.

If you start in June to take a plunge in the lake every morning and continue it every day until December, this same power resident in the body will intelligently adapt the body to the seasonal change in temperature.

This innate power gave the polar bear his long hair, that he might live in the land of eternal ice, and the gentle deer his speed, that he might escape his less swift foe. It is this power that in the struggle for existence gave wings to the birds and cunning to the fox, spots to the leopard and strength to the lion. It is this power that elongated the neck of the giraffe so that he could reach the high-hanging foods and for obvious reasons webbed the feet of the duck and goose. This inborn power adapted the stomach of the carnivora to a meat diet, the stomach of the herbivora to a vegetable diet, and the stomach of man to both.

This power develops the body from a blastoderm to its full growth in thirty-five years; for ten or more it maintains its vigor and then slowly lets the house in which we live decay. During all the circling three-score years and ten it coordinates the physical functions, heals the body's wounds, mends its breaks, adapts it to the change of season, occupation and pursuit and performs the miracle of changing common food into living, breathing, sensate bone and flesh.



DEFINITION

The practice of Chiropractic consists of the palpation and adjustment, with the hands, of the movable segments of the spinal column to normal position for the purpose of releasing the prisoned impulse.

It laughs at all our efforts to locate it or to imitate its work and yet some people, because they cannot find it, weigh it or measure it, question its existence and say "Vital force is a chemical phenomenon."

Call it what you will, it's there—a rose by any other name is just as sweet.

This "power within" Chiropractors call Innate Intelligence and all their philosophy, science and art is built upon this fundamental fact. They teach that "Innate Intelligence" functions through the brain and nervous system, and that disease is but the abnormal expression of one or more of the nine primary physical functions. Any pressure of a harder tissue (bone) upon the soft nervous tissue, impairs the conductivity (function or work) of that tissue and results in disease. All that is necessary for a complete restoration to health, is that the impinging tissue be adjusted to normal position, which permits the nerve again to function normally.

Scientists call the modus operandi of the "power within" the law of adaptation. Among the professions engaged in getting the sick well, chiropractors alone recognize the existence of the thing itself, and the law of its expression, through the nervous system.

That is the reason Chiropractic succeeds where all other methods fail.

Write for information regarding Chiropractors or Schools to the

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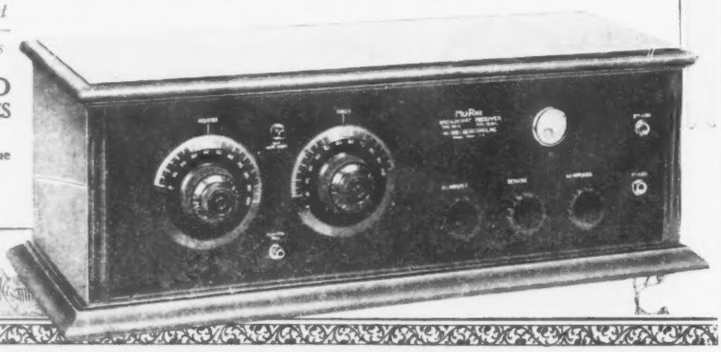

MU-RAD LABORATORIES Inc.
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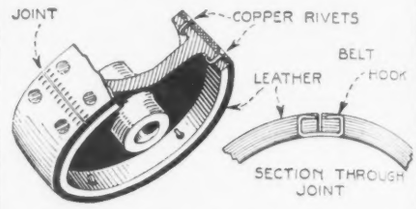
Leather Improves Traction of Small Iron Pulleys

USERS of power-driven machinery often find that belts that run on pulleys of small diameter slip considerably. This is especially true in the case of threshing machines, which drive several shafts through one belt. In such cases the small iron pulleys can be made to grip the belt better if they are covered with leather.

Select a good piece of leather belting of suitable thickness and cut it so that when it is wrapped about the pulley, it will be short by ¼ in. or more. Fasten the ends with wire belt hooks, such as are used on sewing-machine belts. Space the hooks evenly and hammer down the ends below the face of the leather. Then soak the leather in water for a few minutes so that it will stretch over the pulley. When in place, it is bound with cord or narrow strips of cloth and left to dry. Holes are later drilled through both leather and iron and rivets placed as shown.—J. R.

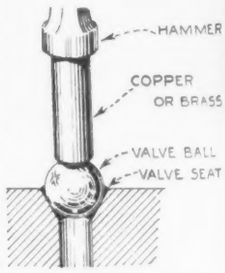


A piece of leather belting is cut to fit the pulley and fastened to it with sunken rivets

Seating a Small Ball Valve

IN MAKING small ball check valves, or other valves where the moving part is a steel or bronze ball, the important thing is to get the valve-ball well seated, so that it will bear evenly all around and be proof against leakage, yet free to move without sticking or binding.

A simple and excellent way to attain this result is to form the seat first with a countersink or specially ground tool having an angle of about 65 degrees, and then lightly hammer the ball into the seat, using a piece of copper or soft brass as a buffer between the ball and the hammer.



Hammering the ball makes a perfect seat

To be on the safe side, do not use the ball with which the seat was made for the actual valve, but use a fresh one, hammering it in as before, but very lightly. This method makes a very good seat in brass.

Nothing is gained by making the bearing surface too wide. A seating width of 1/32 in. is sufficient for a ball 3/16 in. in diameter.

A SERVICEABLE scraper for delicate erasures may be made from a draftsman's broken ruling pen. Simply grind to a knife edge the edges of that part of the blade remaining intact.—J. G. F.

A Coal-Saving of at least 20% is Guaranteed to every user of the CROWN *Fuel Saver*

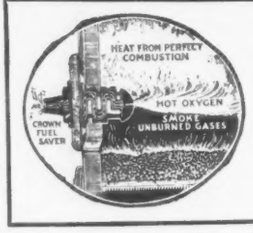
Guaranteed in this case means just what it says. There's no hokum about it, no "ifs" or "buts." Properly attach the CROWN Fuel Saver to the feed door of your heating plant and we *guarantee* you an actual saving in fuel of at least 20%—or *we will refund your money without question.*

Many users of the CROWN obtain fuel savings up to 50%

Over 10,000 satisfied users of the CROWN are getting more heat, steadier heat and cleaner heat. They are cutting down their coal bills ⅛ to ½; eliminating smoke and deadly gases; and reducing the number of trips to fire the furnace.

What the CROWN is

The CROWN is a small device which may be easily bolted to the feed door of any type heating plant without injury to the door. The CROWN (see illustration) provides, by means of natural draft, an auxiliary supply of hot air *over* the surface of the fuel bed. This hot air (oxygen) burns the *rich gases* that are ordinarily lost thru the chimney in the form of "smoke." The CROWN turns this "smoke" into intense heat and assures almost *perfect* combustion.



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Extra High Bench Is Convenient for Delicate Work

WHEN I straightened up one day to relieve my back while constructing a delicate piece of cabinetwork, the idea of a high bench suddenly came to me. I built one at once and now do the majority of my small puttering jobs at it.

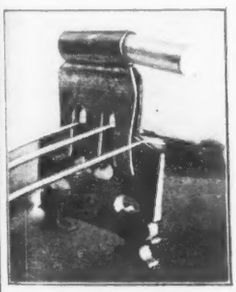
Doing woodcarving at the high bench

The bench is 3 ft. 9 in. high, just right for me to rest my elbows without bending. This is a wonderful help in steadying the hand while doing small, difficult work. The top is about 3 ft. square, which is large enough for such jobs as can be done on a bench of this height. I have also placed a foot rail about 12 in. from the floor. —W. F. MESSENGER, Stillwater, N. Y.

How to Make a Practice Mute for the Violin

THIS practice mute for a violin was constructed from my own design and has proved very satisfactory. With the mute in position the tones of a violin can hardly be heard in an adjoining room.

A metal tube is soldered on the top of an ordinary metal violin mute to take a plug, which is shown partially withdrawn. In this case the plug is a section of bar solder, but lead would be as suitable.



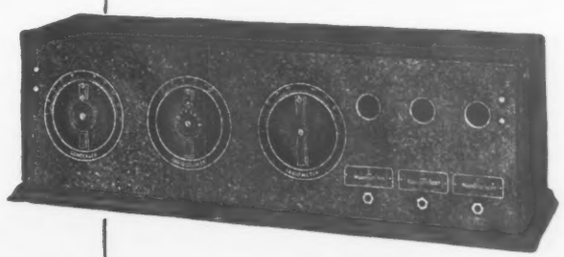
Mute with heavy plug partly withdrawn

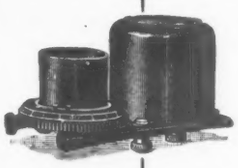
The plug must fit perfectly; any vibration causes an unpleasant quality of tone. I have found a slightly tapered construction of tube and plug (1/16 in. smaller at one end) desirable, and it is well to wrap one thickness of soft paper around the plug.

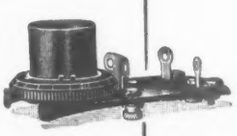
The plug may be soldered in the tube or soldered directly to the top of the mute, if it is to be used for practice work only; but by making the plug removable, the mute may also be used when desired as an ordinary mute.—LESLIE H. PHINNEY, Springfield, Ill.

Fastening Picture-Frame Backs

USED steel phonograph needles are valuable for fastening the backs in picture frames, especially when the frames are small and delicately constructed. The needles will not split the wood and they can be pressed into place without hammering.—ALBERT KORTE, Bridgeport, Conn.







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The crystal black panel finish, together with the concave dials, lend a pleasing effect—the absence of knobs giving a clean, flush appearance.

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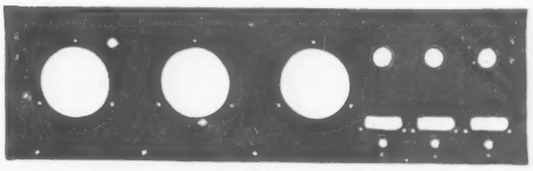

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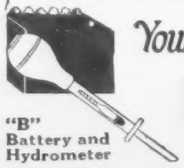

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Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

OF THE drying oils used in compounding and diluting paint, linseed oil is the most important. Before being incorporated in varnishes and paints, it is usually boiled and almost always diluted with turpentine. This makes it dry more rapidly, and it therefore serves as a drier.

The best way of diluting paint is to add turpentine (spirits of turpentine will do). The addition of gasoline or petroleum, which is sometimes used, or benzol (benzene) is not to be recommended. They are just solvents and, having no body, they evaporate, while turpentine oxidizes to a resinous product, which aids in holding and covering the surface.

Putty of linseed oil and precipitated chalk

Five colors are required for mixing any ordinary shade of paint. These are black, white (zinc white or white lead), lemon yellow, carmine, and Prussian blue. Mixing a little black in the white gives a gray shade, although a trace of blue may be helpful in accentuating the gray. Blue and carmine give violet; yellow and blue, green; yellow and carmine, orange. In this way any bright or dull shade can be mixed together in a few moments and thinned with the turpentine and linseed-oil drier.

After use, clean paint brushes at once with plenty of soap and water. If the brush is hard, let it stand overnight in a thick soap solution and clean next morning. If the brushes are rocklike, soften by placing them in a glass or porcelain vessel containing 1 lb. of sodium carbonate (about 25 cents worth) in 1½ qt. of water, which should be kept lukewarm for about a day. The softened brush can then be cleaned with soap and water. When it is necessary to keep a uniformly delicate shade, it is best to clean the brush further with benzol.

Boiling a drier

By boiling raw linseed oil (10 parts) with manganic peroxid (1 part) that has been thoroughly dried and placed in a bag in the oil, a good drier is obtained. It can be taken as a rule never to add too much drier to a paint. A teaspoonful or so is sufficient to a pint.

Not long ago I required a drier immediately and could not buy any because

(*Continued on page 131*)

Home Workshop Chemistry

(*Continued from page 130*)

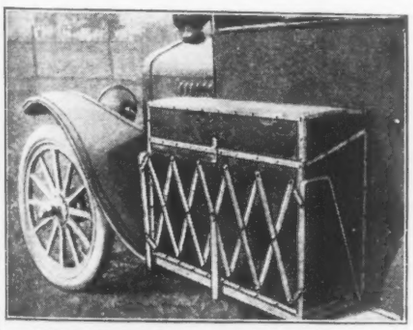
the day was a holiday. I placed less than half a teaspoonful of manganese borate, which I happened to have, in a pint of linseed oil, and brought the whole to a slight simmer for a quarter of an hour. When it was cool, I had a drier that would dry in 24 hours. It proved also to be an excellent and practically colorless varnish.

A paint made up with white lead requires a slight amount of drier, but a drier is not added when red lead is used as a color, for red lead imparts drying properties to linseed oil. When a non-tacky surface is essential, as for floors and chairs, a drier made with a lead preparation, such as red lead or lead acetate is to be preferred over the manganese type.

Raw linseed oil, which dries much more slowly than boiled oil, may be mixed with precipitated chalk and kneaded to a dough to form a putty that remains soft for quite a time.

Runningboard Trunk for Long Auto Trips

FOR long auto trips, this runningboard trunk has proved most useful. It is 10 by 18 by 30 in., made of ½-in. white pine and covered with medium-weight imitation leather. The lid is 6 in. deep in front and 2 in. deep in back. The corners and edges are bound with zinc cut in strips ¾ in. wide and fastened with brass-headed upholstery nails. One or two suitcase fasteners hold the cover shut, and a lock and handles can be added, if it is desired.



This imitation leather-covered auto trunk fits the luggage carrier on runningboard

While the trunk might be made larger, it is commodious enough for average purposes and has the advantage of fitting into a standard runningboard luggage carrier. —HAROLD JACKSON, Kankakee, Ill.

Improving a Cheap Paintbrush by Setting Hairs in Varnish

AT TIMES, when a good paintbrush is not at hand and the work to be done does not warrant the purchase of one, a cheap brush may be made to serve by setting the hairs in varnish.

Dip the brush so as to submerge all the hair and work out the surplus varnish while holding the handle down. Then let the brush dry for 24 hours, handle down and hair up. A wire holder can be made in half a minute to hold the brush in this position while the varnish is drying.—L. W. FEAGIN.

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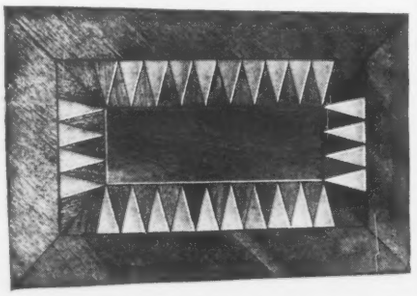
POPULAR SCIENCE MONTHLY
225 WEST 39th St., NEW YORK

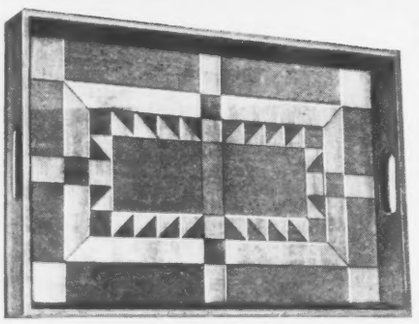
Inlaid Serving Trays Made with Cigar-Box Wood

By M. W. Lowry

AN ATTRACTIVE serving tray with an inlaid effect can be made by sawing the wood of cigar boxes into small pieces and gluing them on a thin base to form a pattern.

Tear apart several cigar boxes and remove the paper covering by soaking and scraping. It will be found that some boxes are of cedar or similar wood having a beautiful grain, while others are poplar or other white or nearly white wood with very little grain. Sort the pieces of wood



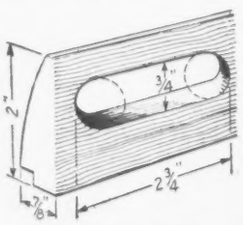


An "inlaid" bottom before framing (above) and a tray with another pattern (below)

according to color and grain, and dry thoroughly.

The usual size of these trays is 11 by 17 in. The pattern should be worked out to conform to these proportions. A good way to start is with a panel of dark wood in the center 3 by 9 in., which will leave 4 in. on all sides to be filled in. The design can be worked out with alternating light and dark woods in squares, triangles, rectangles, and other shapes, according to the designer's fancy.

A few sheets of cross-section paper are a great aid in laying out the pattern. Let the large squares represent square inches and fill in by shading the portions that are to be dark wood. The direction of the grain can also be indicated, and a good working plan made. When one gets started, numerous patterns suggest themselves.



Detail of tray molding and handles

For the base on which to glue the pieces, select three-ply veneer or a piece of thick, heavy pasteboard or wallboard about ¼ in. thick. This should be left a little larger

(Continued on page 133)

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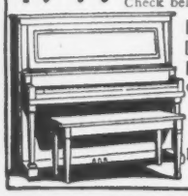

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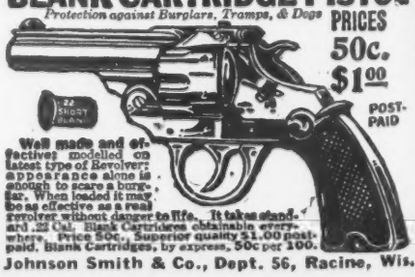

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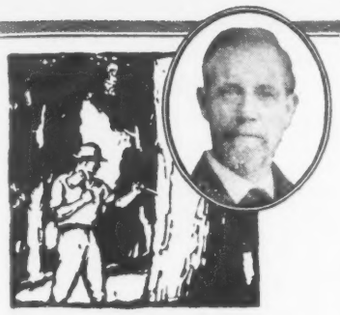

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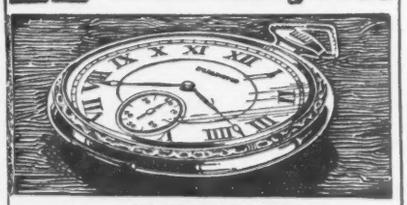
21 Jewel Burlington



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Inlaid Serving Trays

(*Continued from page 132*)

than the tray is to be and should be tacked around the edges to a wide board, so that it will be held straight until the bottom is finished.

When the selected wood has been cleaned and dried, it is cut with a miter box and fine backsaw into pieces of the desired shapes and sizes. The edges are smoothed off with fine sandpaper. The pieces are then glued to the base, care being taken that they fit quite closely, with good joints. They must be braced from the sides till the glue sets or they will creep apart.

Where a line of small pieces are put on next to a large piece, it is best to put on the small ones first, as far as possible, as it is easier to fit the one large piece than the many small ones.

When the glue is dry, dress off the surface with a sharp plane until smooth. Finish with fine sandpaper, and oil or wax the surface. Wax brings out the grain beautifully and gives the wood a very rich appearance. The edges are then trimmed to the correct size.

Tray Frame and Handles

The framing can be done by any picture-frame maker, who usually will have molding suitable for this purpose. If it is desired to have the whole tray handmade, the molding can be made from birch, maple, gum, mahogany, or walnut strips 2 in. wide and ¾ in. thick. Cut a rabbet along one edge to receive the bottom of the tray and bevel and round the inside edges. Leave outer edges straight.

The handles are cut in the end pieces by boring two ¾-in. holes 2¾ in. apart from outside to outside and chiseling out the wood between. Put the frame together and varnish with mahogany or walnut varnish stain, finishing with a coat of clear hard varnish. Then insert the bottom under a piece of glass, fastening it in with tacks.

The under side of the whole tray should be covered with felt.

FEATURES FOR MARCH

How to make—

A neutrodyne radio receiving set. In order to obtain the best and clearest article yet written on assembling a neutrodyne set, POPULAR SCIENCE MONTHLY turned to Prof. Louis A. Hazeltine, the inventor. He has lent the services of John F. Dreyer, Jr., Chief Engineer of the Hazeltine Research Corporation, for the preparation of this important feature.

A Chinese game table. Now that "punging" and "chowing" have become one of the most popular indoor amusements, George F. Kaercher has designed an especially convenient and attractive table for playing the game and it can be made at relatively small cost.

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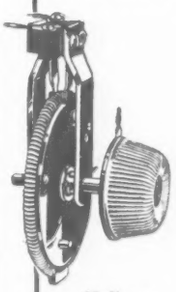

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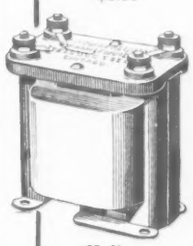

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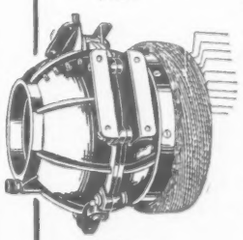

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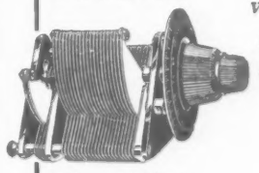

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Keeping the Home Shipshape

How to do the odd jobs that save time, temper, and money

Doorbell Transformers

TO INSTALL a transformer for operating a doorbell with electric current from the lighting circuit, first determine the voltage of the line (usually 110 or 220 volts). Then buy a transformer that is suited to that voltage.

The voltage on the secondary or doorbell side of the transformer may be six or 12 volts or two or three different voltages. If the latter type is obtained, it will be possible to draw one voltage for one purpose and another for another purpose—as 12 volts for the doorbell and 24 for a 24-volt motor.

The rubber-covered wires leading from the transformer shown in Fig. 1 go to the lighting line. The binding posts on the top are for the bell connections. This photo-diagram shows a standard hook-up of transformer, bell and button.

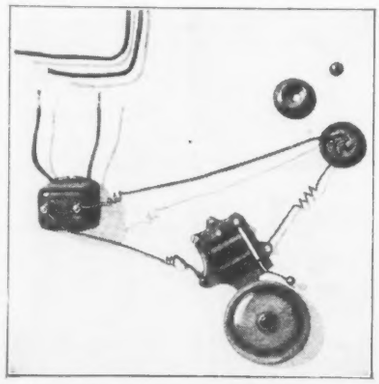


Fig. 1. Photo-diagram of the doorbell circuit using a transformer instead of batteries

To conform to the requirements of the Board of Underwriters, the following points must be observed and carried out in making the installation:

All joints or splices on the line side must be soldered after the wires have been scraped, then wrapped with rubber tape and the whole covered with friction tape.

The transformer must be placed on a sheet of asbestos of approximately three times the area of the base of the transformer and, while not absolutely necessary, the wires leading to the bell should be rubber-covered.

When making connections (this applies to all connections of a similar sort) the wires should be cut longer than necessary and the extra amount wrapped several times about a pencil to form a coil. Then, if a connection should break, there still will be enough wire to reconnect without making another splice or using new wire.

One of the best places for the transformer is on the under side of the first-story floor, if the home has a basement. Since it does not require attention, it is out of the way there and when properly installed is perfectly safe and foolproof. Many installations, however, are made in the fuse box when the box is of sufficient size for the purpose.

How a small transformer, such as the one just described, can be installed in a box of its own is indicated in Fig. 2. The coffee can, which has a tight cover, is fastened to the wall with screws. The inside is lined with asbestos and porcelain tubes, or bushings, are used where the wires pass through the tin, at least for the lighting circuit.

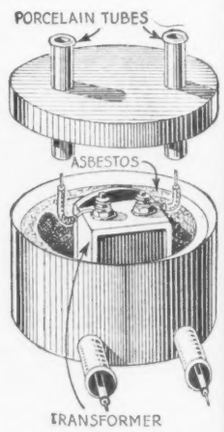


Fig. 2. Transformer in asbestos-lined can

$50 FOR SHIPSHAPE HOME IDEAS

HOW do you keep your home shipshape?

For the best letters containing practical, novel, and ingenious ideas on this subject, POPULAR SCIENCE MONTHLY will give a first prize of $25, a second prize of $15, and a third prize of $10, and will purchase at space rates as many other contributions as are available for use in the Shipshape Home columns.

Take for your title, "How I Keep My Home Shipshape." Tell your own experience—what you actually do in the way of woodworking, painting, and varnishing, wallpapering, plumbing, and the like. Don't simply catalog a number of odd jobs. Pick out one or two of your own ideas that have been particularly successful in reducing the upkeep cost of your house or apartment and describe them in such a way that other readers will be able to make profitable use of the same methods. This is a contest intended primarily to help the other fellow.

Keep your letter short—not more than 400 words. Inclose photographs or pencil sketches, if possible, to illustrate the ideas or methods.

The competition will close February 20. The winning letters will appear in the June issue. The contest will be judged by the Board of Editors and their decision will be final. Unavailable letters will be returned if accompanied by stamped and self-addressed envelopes.

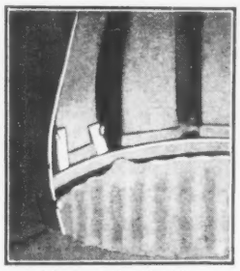
Address Shipshape Home Editor, POPULAR SCIENCE MONTHLY, 225 West 39th St., New York.

The Shipshape Home

(*Continued from page 134*)

Repairing Furnaces

STOVES and furnaces frequently develop cracks and these sooner or later involve costly and troublesome replacements. This expense often may be avoided or indefinitely postponed by stopping the progress of the crack and repairing the break as soon as they appear.



Two patches inside hot-air furnace

The photograph shows part of the interior of a hot-air furnace with cast-iron air ducts resting on the firebox. After a few years of service, the ducts developed five cracks at their junction with the firebox, with the result that coal-gas escaped into the rooms above through the air pipes.

The progress of the cracks was arrested by drilling a small hole just a trifle beyond the limit of each one and in the line of its path. These holes were tapped for ¼-in. stove bolts, which were used to hold pieces of heavy galvanized iron over the crack. Furnace cement under the patches helped to make them gastight.

The furnace has survived two winters' usage since being repaired and is in good shape.—O. S. MARSHALL, Springfield, Vt.

Planes and Planing

SKILL in the use of both wood and iron planes has to be acquired. A great many men earning their living with woodworking tools cannot clean up a cross-grained, brittle piece of wood in a thoroughly workmanlike manner.

Tearing the wood is perhaps the most common fault of the home worker. This means that rough places are left on the surface, especially around knots. To remedy this the cutting blade must be kept sharp. It must have the right taper when ground in the first place and the back iron must fit down tightly and snug. For fine work the back iron should be close to the edge of the blade. The wedge or cap iron must fit tightly and hold the blade firmly and solidly.

With a sharp, properly adjusted plane set fine, any one should be able, with ordinary care, to clean up cross-grained wood.

When planing, pressure should be put upon the front of the plane with the left hand. The right hand is used only for pushing, except at the very end of the board, when the pressure is transferred to the rear handle so that the wood will not be tapered down. If a plane were heavy enough, it only would need to be pushed, but as they usually are light, some pressure is required, and practice soon teaches how much this should be.

If, after taking a few strokes, the plane chokes up, it will be because the above precautions have not been taken or be-

(*Continued on page 136*)

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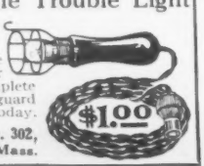


The Shipshape Home

(*Continued from page 135*)

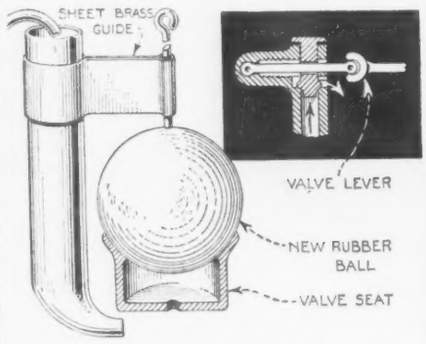
cause some imperfection in the mouth of the plane holds the shaving instead of allowing it to curl out easily. By careful observation the cause often may be found and remedied.

If you find slight marks or lines on the work, it will be because the cutting iron did not have the corners slightly rounded when sharpened. This always should be done.—A. E. E.

Repairing Flush Tanks

PLUMBING repair bills often can be avoided if the home worker will take the time and trouble to do the work himself. Recently our plumber condemned the flush tank in our bathroom and said that a new one would have to be installed at a cost of from $15 to $20. I was convinced that I could make the old tank work practically as well as new with about an hour's work and 10 or 15 cents expense.

Our ball valve was of the old type with rubber collars that continually stretched and let water leak through. By making



Two simple repairs to a flush tank that saved a $15 or $20 plumbing bill

the sheet-brass guide shown, I was able to substitute a rubber ball of the standard type.

Another difficulty was that the float would not always act certainly, the plumber's diagnosis being that the valve parts were so worn out as to be useless. The difficulty really was that the valve lever jammed against the socket of the float lever when the float had reached a certain point while rising. This was remedied quickly with a round file, so that there was ample play between the two levers. The parts were not worn out at all and the flush is now good for a lifetime's usage.—O. S. M.

Cleaning Traps

A COILSPRING about 2 ft. long and ¼ in. in diameter is useful in cleaning the clogged trap of a sink, lavatory, or bathtub. Pull out one end of the spring until it looks like a corkscrew, and make a loop in the other end large enough so that a wooden rod or peg will slip through it. Then use the spring as an auger and screw it into the trap through the clean-out opening. You can fish almost anything out of the pipes by this means, and it will sometimes save a plumber's bill.—L. W. FEAGIN, Long Beach, Cal.

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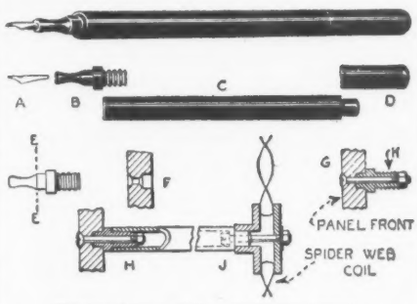
Old Fountain Pen Barrel Supports Spider-Web Coil

A NEAT, serviceable, well-insulated support for a spider-web coil can be made from a discarded fountain pen. The pen and cap parts *A* and *D* are discarded. The penholder *B* is cut off as shown at line *E-E*.

The detail *F* shows how the 5/16-in. panel is drilled. The holes will have to be shallower if the panel is less than 5/16



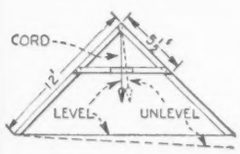
Fastened to a radio panel, the barrel of an old pen forms the coil support

in. thick. Detail *G* indicates how the pen is bolted in place with a French oval head machine screw. Care should be taken to file off the corners of the nut so that they will come slightly below the root diameter of the threads *K*. This is so that the nut will not interfere with screwing on part *C*. The detail *J* suggests one coil arrangement, which may be modified to suit the inductance to be mounted. The type of coil used by the author is a self-supporting Reinartz inductance.—FRANK W. HARTH.

Plumb-Bob Level Aids in Grading and Ditching

FOR laying out ditches, terraces, fence rows, and the like, and measuring short distances, the level illustrated serves very well and can be quickly and cheaply made.

The device is like a huge fixed divider or compass, with two 12-ft. legs made of straight and strong wooden strips. These are fastened exactly at right angles to each other and braced by a crossbar.



How the level is made and used

A plumb-bob hangs from the juncture of the legs, as indicated and the cord swings opposite a scale marked for a few inches on both sides of the center of the cross arm. These graduation marks enable one to give a ditch, terrace, or row a certain amount of fall by moving one of the instrument legs to higher or lower ground until the cord hangs directly in front of the desired mark.

When it is necessary to measure short distances or lay off fence rows, the bob should be removed. Then hold the level in both hands and swing it so as to describe a series of semicircles, as in stepping off a line with dividers, but be careful, of course, to go straight. Only approximate results can be obtained this way, but they are accurate enough for ordinary farm purposes.—B. KENNEDY, McCool, Miss.

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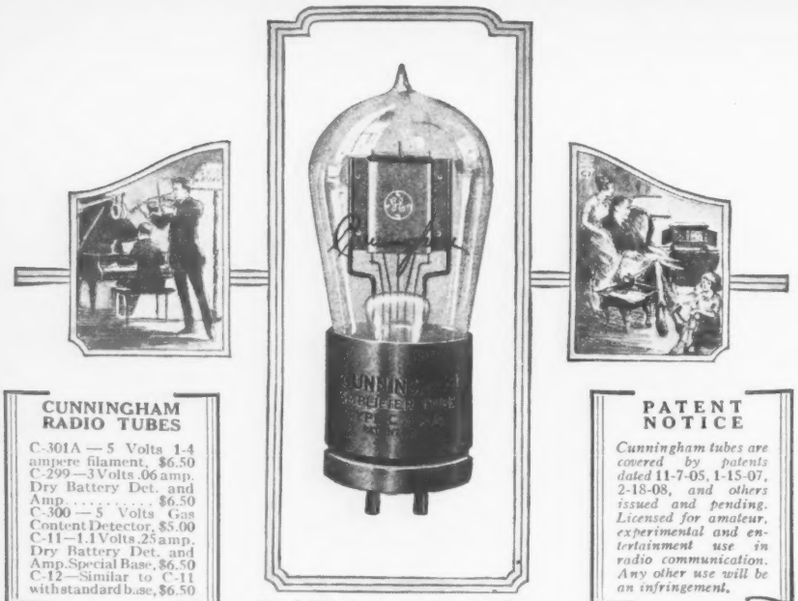

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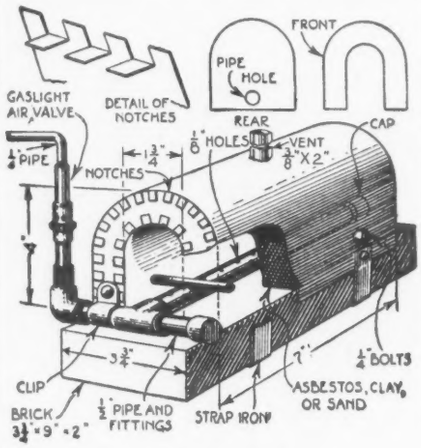
Double Wall Soldering Furnace Heats Coppers Quickly

FOR some time I have been using a soldering furnace made from odds and ends found around my home workshop. It is economical in the use of gas and will heat a medium soldering iron in about a minute and a half.

The base is made of vitrified brick. The furnace hood is composed of sheet metal, bent and fastened as shown. Straps riveted to it are turned under the base.



The heavily insulated hood over the gas burner prevents loss of heat

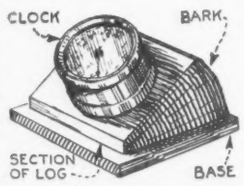
The space between the outer casing and the inner lining is filled with sand, clay, or asbestos.

The burner is made up of ½-in. pipe, ells, and caps. The 9-in. length of pipe, which extends into the furnace, has fifteen ⅛-in. holes drilled into it. These holes are grouped near the tee, so that at least 4½ in. of the pipe toward the capped end will serve as a chamber for retaining air. An air port for a gas light is connected as shown, and is a push fit in a ½-in. nipple. Use three ⅝-in. bolts 4 in. long through the hood as rods upon which to rest the soldering iron.—LORIN A. BROWN, Washington, D.C.

Old Auto Clock Converted into Desk Ornament

THE dashboard clock from an old, dismantled auto, or even a cheap miniature alarm clock can be converted into an ornamental desk clock by mounting it on a triangular block cut from the limb of a tree.

The wood is shaped as shown, care being taken to leave the bark intact. A hole is cut into the block with an expansive bit to suit the clock. If an alarm clock is used, a somewhat smaller hole is bored deeper into the wood to make a recess for keys.



Mounted on rustic base

A thin board is cut slightly larger than the block to act as a base. All but the bark-covered side of the wood should be carefully smoothed, scraped, sandpapered, and varnished.—FRANK W. HARTH, Bayside, N. Y.

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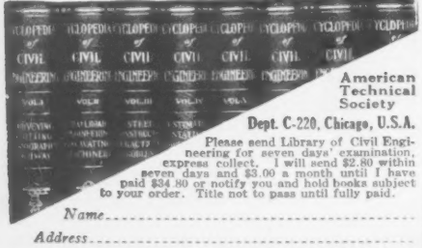

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Saving Money in Building

(*Continued from page 81*)

a balustrade is set in place after it is constructed, surplus should be allowed for fitting.

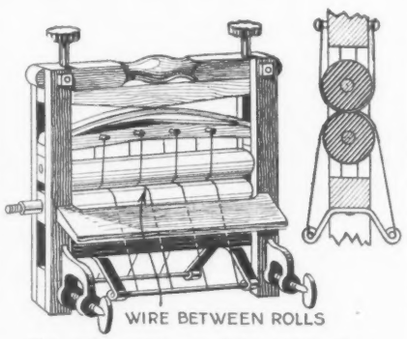
Another useful idea is the method shown in Fig. 2 of reversing plowed window jambs of the double-hung type for use in casement or French windows. This idea can be used for windows opening either in, as shown, or out, and is much cheaper than the usual form of construction.

One other useful "kink" is shown in Fig. 2. I have often found it necessary to make splices or mitered joints, and this can be done quickly and accurately by nailing the two pieces to be joined together temporarily and making a cut at random through both of them. This will always give a perfect fit.

Simple Wire Guards Prevent Wringer from Jamming

LIGHT pieces of clothing and linen often stuck to the wet rollers of the power wringer on our electric washing machine. They would wind around until the machine jammed and this sometimes tore the cloth and broke buttons, as well as putting much unnecessary strain on the gears.

To overcome this difficulty, I attached four strands of No. 18 copper wire with



The guide wires stop light articles from clinging to the rollers and clogging them

screws as shown to guard the upper and lower rolls. After they were in place, I started the wringer and screwed the upper roller down tight. The wires cut into the soft rubber about 1/32 in., enough to hold them in place.

The device has worked well not only on our own wringer but on several others to which I have applied it. The wires do no damage to the clothing and the buttons will not catch if they are turned in as is always required in using a power wringer. —WALTER T. MARKOWSKI, Camden, N.J.

Combination Ink-Pencil Eraser Removes Rust from Knife

HAVING a gold penknife, the blades of which were becoming ruined from non-use and rust, the writer cleaned the steel with an ordinary combination ink-pencil eraser. The rust quickly vanished upon being rubbed with the ink part of the eraser, and the pencil part of the eraser polished the blades.—K. M.

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Edison, the Man

(Continued from page 32)

table, roll his coat about them for a pillow and lie down to sleep for an hour or two.

"A soft bed spoils a man," he had a habit of saying at such times.

He might have gone home to sleep, for he lived only a short distance from the laboratory, but it was characteristic of him, of his thoughtfulness and consideration for others, that he preferred to snatch a short nap with his assistants.

Besides his enthusiasm, his energy, his inventive genius, Edison's chief characteristic, I would say, always has been his sense of humor. No work ever was too serious for him to see the funny side of it—if a funny side happened to develop.

In the spring and summer of 1879, I remember, the bulbs we were using in the lamp experiments were being made by Ludwig Boehm, an expert glass-blower from Bonn, Germany. Edison had discovered that the lamp filaments were more durable and the light more brilliant when the filaments were inclosed in a high vacuum. Boehm was experimenting to find the best method of obtaining a complete vacuum and then sealing the bulb to retain it. One day some one suggested to Boehm in the hearing of Mr. Edison that the bulbs be taken up in a balloon to a height above the atmosphere where no air could reach them.

A "Brilliant Idea" Wasted

"That's a good idea," said Mr. Edison with a merry twinkle in his eye. "I think we ought to get a patent on that."

"And how," the practical Boehm demanded, "are you to seal the bulbs without any air to use in the blowpipe?"

"There you are," exclaimed Edison in feigned chagrin. "A man can't advance a brilliant idea without somebody trying to show him some reason why it can't be done. There's not much chance for an inventor nowadays."

When I heard that Edison was bringing old Jep Bisbee from Michigan to fiddle for the phonograph, I was not at all astonished, for Edison always has been most loyal to his friends. Thus, J. V. MacKenzie, the old Scotchman who had first taught Edison telegraphy, used to stay at Menlo Park for months at a time and had a free run of the laboratory. He was good-natured, happy-go-lucky—anything but the typical thrifty Scotchman. He used to stroll about the laboratory or sit beside the stove telling excruciatingly funny stories in Scotch, German, and Irish dialects.

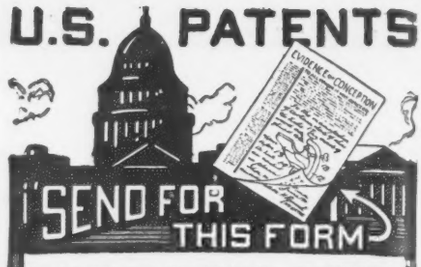
One day when Mr. Edison was carbonizing various substances to serve as a basis for lamp filaments, his eyes happened to fall on MacKenzie's heavy, red beard.

"There's something we haven't tried yet!" he cried, and as he spoke he plucked a wisp from the whiskers.

"The Edison-MacKenzie" lamp, as Mr. Edison styled the bulb in which the old Scotchman's hair served as a filament, burned with a peculiar reddish glow.

"And what would you expect, boys," Mr. Edison asked us, pointing to the color of the light, "when we've used such fiery

(Continued on page 141)



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Edison, the Man

(Continued from page 140)

whiskers as those?"

That Edison, famous for his industry and energy, should have possessed real affection for so carefree a man as the old Scotchman is not remarkable. To MacKenzie he owed, in a way, a tremendous debt, for Edison's first introduction to electricity came from the tutelage which the Scotchman had given him in telegraphy.

Nor was it merely to personal friends that Mr. Edison displayed loyalty and kindness. To his employees he always was the most considerate of men. After I had been at Menlo Park for about a year I was attacked by malaria. We were busy at the time, and I made no mention of being ill, but tried to fight off the illness while I worked. One day, though, Mr. Edison called me aside.

"Francis," he said, "I've noticed you haven't been looking well of late. I think you ought to go to Asbury Park and stay three or four weeks. That ought to fix you up."

Not only did he relieve me from my duties at the laboratory for a month, but he gave me the money to pay the expenses of my vacation at the seashore.

The Inventor as an Organist

The youngest of us was no more lively than Mr. Edison in his moments of relaxation. He enjoyed nothing better than a good rousing song. Few people probably know it, but in those days at Menlo Park, Mr. Edison was more than a fair performer on the organ. After our midnight lunch at the laboratory he would stroll to the organ at the end of the long room, and soon our voices would be ringing out in the popular songs of the day to his accompaniment. Boehm, the glass-blower, sometimes could be coaxed to play the zither and sing quaint German songs. One of the laboratory boys was an excellent mimic. He had an imitation of the original Edison phonograph, with the tinfoil records, which never failed to elicit peals of laughter from Mr. Edison.

Sometimes Hussy, postmaster of Menlo Park, or Davis, the innkeeper, would join us at these midnight revels. One night Hussy, who sometimes might exaggerate a wee bit, began to tell his life history. Incident followed incident, but the narrator showed no signs of weariness nor of reaching the end of his story. Mr. Edison, who was somewhat deaf even then, sat by, apparently paying no attention to the speaker. Suddenly, though, he took out a piece of paper, scratched some figures on it, and then looking up, said:

"Hussy, how long are you going to keep on working? Up to now I've figured that you've been working more than 150 years! Isn't it about time you took a vacation?"

This was said in an even tone, apparently with perfect good humor, yet we who knew him best saw that Mr. Edison was vexed by the old postmaster's lengthy autobiography. For he always resented being imposed upon or having his credulity taxed even in small things.

Mr. Edison's self-confidence was su-

(Continued on page 142)

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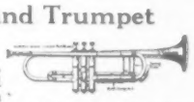

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Edison, the Man

(*Continued from page 141*)

perb. The present generation, accustomed all its life to obtaining light by the simple act of pressing a button, probably will have difficulty in imagining the ridicule and criticism that met Edison's efforts to develop the ancestor of the electric lamps that light our homes. It is even more difficult to believe that some of the foremost scientists of the time went so far as to call Edison, in effect, an ignorant and deluded man. But criticism, no matter how bitter, bothered him not at all. He was certain that eventually he would solve the problem of producing the incandescent light, and his faith in himself made him impervious to the attacks of his critics.

Typical of the criticism of Edison by the scientists of those days was that of Sylvanus P. Thomson, a great English electrician, who spoke of Edison's "airy ignorance," and made the positive statement that any system of lighting dependent upon incandescence would fail. Not only that, but he proved it to the satisfaction of many!

Unmoved by Critics' Attacks

W. H. Preece, electrician to the British Post Office Department, one of the greatest English electricians, and a pioneer in wireless telegraphy, pledged his reputation to the assertion that Edison's idea was a "mere chimera" and was doomed to ignominious failure. Mr. Edison likes to remember that Preece later became one of his warmest friends and staunchest admirers. Other scientists declared it absurd that a man like Edison, who was "not even a mathematician," should presume to set himself to the solution of problems that had baffled learned scientists.

None of these attacks, however, ever brought from Edison a reply or a countercharge. Reporters from the New York, Philadelphia, and Boston newspapers were besieging the Menlo Park laboratory constantly, laying the latest charges of his critics before Mr. Edison and seeking to arouse him into making a sensational statement in reply. Usually he warded off the questions of his visitors diplomatically. Sometimes he became a little impatient. One day he said:

"I'm not working at the electric light for the sake of making a public exhibition of it, nor for the sake of announcing each step I take. I am working for a company, the Edison Electric Illuminating Company, and my only business is to supply that company with a perfect system of electric lighting."

He *knew* he would be successful, and he knew as well that his success would be the most formidable answer to his critics.

Not that he was entirely careless of criticism. On the contrary, he was eager to read every line printed about him and his work. It supplied him, I believe, with a spur, driving him on to increased efforts. Whenever any of us would come across a particularly savage attack, Mr. Edison would read it; then he would smile and say, "Never mind, boys. They'll not only be reading by incandescent lamps soon,

(*Continued on page 143*)

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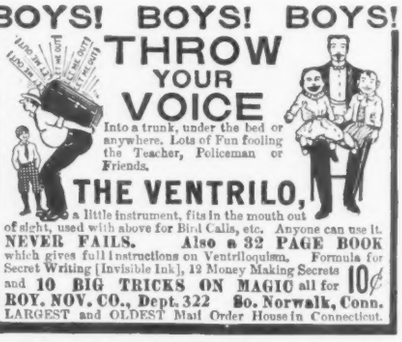

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Edison, the Man

(*Continued from page 142*)

but they'll be running their elevators and sewing machines, and cooking their meals by electricity, too!"

I never saw Mr. Edison discouraged—not even in the days when, after experimenting with platinum lamps, he gave them up and sought again to develop a carbon filament. At that time people were fond of comparing the incandescent lamp with the Keeley motor. Mr. Samuel Insull, now head of the power industries of the Middle West, who once was Edison's secretary, however, tells of one time when the inventor became pessimistic.

"Sammy," Mr. Insull says Edison asked him one day, "do you think you can earn a living again as a stenographer? Because, if you do, I think I can earn my living as a telegraph operator. That will make us certain of having something to eat anyway."

That was in 1883 when Edison had started a lamp factory and the whole future of the Edison light system depended on its success. And it was a matter of financing a giant project, not of developing an invention, that had brought doubt of success to Edison's mind. Lacking sufficient capital, Edison nevertheless had plunged into the business of manufacture, because he alone possessed sufficient faith in the future of electric lighting to do so. Though it was costing him between one dollar and one dollar and fifty cents to manufacture each lamp, he had taken a contract to sell lamps at 40 cents apiece! Scant wonder that he saw visions of starting all over again as a telegrapher in order to live!

Edison's Critics Silenced

He and Insull, though, attacked their apparently hopeless task with courage and determination. They pored over accounts and managed to meet the payroll somehow until Edison had placed his factory on a sound economic basis. At last the tide turned. The public woke up to the fact one day that the Edison factory was actually paying dividends. Edison's critics were silenced!

Problems equally difficult confronted Edison while erecting the first permanent commercial central electric-light station in the world in Pearl Street, New York City. Here again his indomitable perseverance overcame apparently insurmountable obstacles. Mr. John W. Lieb, now vice president of the New York Edison Company, was the first electrician of the Pearl Street station and participated in those stirring events.

While Edison was establishing these stations, there were times when all of us at the laboratory worked 36 or 48 hours at a stretch—sometimes longer. For the revolutionary undertaking necessitated the development of many inventions. The electric transmission line of those days was a single circuit, supplying current to arc lamps connected in series, which meant that when one lamp got out of order every lamp in the circuit went dark.

Yet even at the height of the work,

(*Continued on page 144*)

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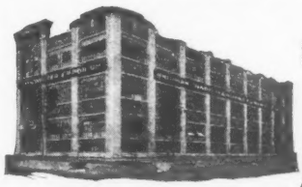

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"I have averaged $7000

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That is the statement of Frank DePries, one of our live-wire representatives. Keeton of Mississippi made $252 on his first sale. Vickers of Alabama made $118 in one week. Conant quit a $6,000 job to come with us.

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Ford Auto FREE!

We have a plan whereby our active workers can get a Ford without cost, in addition to their big cash earnings. Get the plan—quick!

AGENTS WANTED

We need more men like these, because the demand for our *Super Fyr-Fyter* is growing by leaps and bounds. Sells to garages, stores, factories, schools, homes, hotels, auto owners. Approved by the Underwriters. If you are willing to work and ambitious to make some real money, get our plan. You need no experience, as we train you without cost for the work. No great capital required. Good territory going fast. Better write us at once.

THE FYR-FYTER COMPANY

1714 Fyr-Fyter Bldg. Dayton, Ohio

What I Learned About Old Age

By Byram C. Kelley, A.M., LL.D.

CERTAIN new facts about old age, recently disclosed to me, constitute the most startling information I have ever received. I am 40 years old myself. I had begun to wonder if I would soon begin to "break"—to lose my old-time pep and aggressiveness, my stamina and resistance to disease. I wondered if I would soon be subject to the class of ailments which seems so prevalent among men past 40. Then through a mutual friend, I made the acquaintance of a member of the American Association for the Advancement of Science, who has recently brought to light most interesting facts about the peculiar conditions common to men past middle age.

Why Many Men Are Old at 40

I had often wondered why so many men begin to lose their vigor and alertness when they are scarcely out of their 30's—yet others, at 60 and 70, seem to be in the prime of life. There must be some reason for this difference. And I found out exactly what this reason is.

65% Have Gland Trouble

I have learned that 65% of all men past a certain middle age have a disorder of a little gland, called the prostate. And prostate disorder is not only the direct cause of much distress, often necessitating operation, but it displays itself in many parts of the body mental as well as physical.

Common Middle Age Ailments

Here is an important cause for many ailments which heretofore have been simply taken for granted as "old age" symptoms—sciatica, aches in back, legs and feet, frequent nightly risings, nervousness and irritability and frequent dizzy spells indicating high blood pressure; and I learned how, by an astonishingly simple new method, that these disorders would be eliminated in many instances in a short time, without drugs or operation—a treatment that reaches this gland directly—yet is so convenient that any one can apply it in their own home.

10,000 Men Find Relief

But most surprising of all, I find that 10,000 men have already found relief. Statesmen, bankers, lawyers, doctors, in every section of the country are using and endorsing the method. I read many letters. One was from a man in Colorado. "73 years young is my age," he wrote, "yet for years I suffered with prostate trouble. Used medicine to no avail—had about given up hope when a doctor recommended your treatment." Just think of a man 73 years old being restored to the health and buoyancy of youth! And it is within the reach of every one. There are no drugs, no books, no electric rays.

73 Years Young

All Explained in FREE Book

If you are troubled with any of the disorders mentioned, if you have chronic constipation or prostate trouble, you should send for a vitally interesting free book, written by this scientist, called "Why Many Men Are Old at 40." It describes this splendid treatment and shows how you may regain much of your youthful vigor and be free from certain disorders. No obligation. But write at once—the edition is limited. Simply mail request to **The Electro Thermal Company, 4030 Main St., Steubenville, Ohio,** the concern that is distributing these books for the author.

Edison, the Man

(Continued from page 143)

Edison never was too busy to see any one who sought him out in his isolated New Jersey retreat to discuss an invention or some other ambitious undertaking. His own experience had taught him the value of encouragement to a pioneer. His own progressiveness caused him to be eager to foster progress in any direction. His kindliness made him always willing to help others.

Early in 1879 Lieut. G. W. DeLong, of the United States Navy, who was making preparations for a voyage of arctic exploration, came several times to Menlo Park. Edison became so much interested in his plans that he designed a small dynamo, some incandescent lamps and an arc lamp for his ship, the *Jeanette*, which was being refitted for the expedition by James Gordon Bennett. Since the ship had no steam engine that could be used for the purpose, Mr. Edison designed the little dynamo to be operated by man power—in shifts of two men.

"The boys ought to keep warm up in the arctic, turning that," he observed to Lieutenant DeLong when he showed him the dynamo.

A Visit from Sarah Bernhardt

All of us who worked in the laboratory wrote our names on the paper insulation that was wound on the armature. And somewhere beneath the arctic seas our names have lain for almost half a century, for the *Jeanette* never returned.

Distinguished visitors almost without number found their way to the Edison laboratory even in those early days, for, although scientists were skeptical about the success of the incandescent lamp, Mr. Edison had won fame with other inventions, principally—so far as the public was concerned—the phonograph.

Sarah Bernhardt was one of the visitors of 1880. We were accustomed to seeing Mr. Edison reserved, shy, even, in the presence of strangers. There was little shyness in his manner, though, as he explained the workings of the phonograph that day, a fact which requires no explaining to anyone who ever has seen the Divine Sarah swaying vast audiences in the theater. And that day, for the first time, the voice of an internationally famous artist was recorded on the talking machine.

Madame Bernhardt was transported with amazement when she heard her own incomparable voice and accents reproduced by the record.

"C'est grand! C'est grand!" she exclaimed again and again in frantic enthusiasm.

I cannot believe that Thomas Edison ever received more rapturous praise for any of his achievements than the great French actress bestowed upon him that day. Moreover, I am quite sure that no words he ever heard pleased him more. Since then the world has worn a path to his door, but never in its journeys to the doors of the great has the world numbered among its pathfinders any one more gracious or more charming than Bernhardt was that day!

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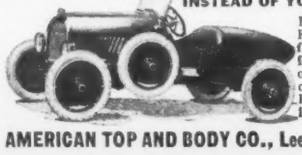

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$60 to $200 a Week

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With 4½ or 6 inch blade..... $3.75
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Dealers are invited to write for our proposition on this and other Simore "Lightning-change" tools. The Combination knife and screwdriver is a sure seller.

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DEAF

is to the ears what glasses are to the eyes. Invisible, comfortable, weightless and harmless. Anyone can adjust it. Over one hundred thousand sold. Write for booklet and testimonials.

THE MORLEY CO., Dept. 797, 10 S. 18th Street, Philadelphia

Senses and Common Sense

(*Continued from page 38*)

Ninety-nine men in a hundred, feeling a piece of cloth, and receiving just as many touch impressions from its temperature, texture, roughness or smoothness, would pay no attention to them, just as they probably would fail to observe whether the dials of their watches contained Arabic or Roman numerals. And those 99 men would remain in the crowded ranks of poorly paid routine workers, while the hundredth man became a textile expert at a high salary.

I have seen expert machinists gaging the thickness of metal pieces almost as accurately as with a micrometer by feeling them. Others achieve the same degree of accuracy with their eyes. Especially gifted men? Not at all. Merely men who have learned the habits of attention and of interpreting their sensations correctly. At the beginning their jobs depended on this faculty, and in time the habit of attention, instead of being irksome, became comparatively easy.

If you drive an automobile or ride in one frequently, you probably have learned to judge speed and distance. Certainly you can distinguish between a speed of 25 miles an hour and 30 miles an hour without consulting the speedometer. A few years ago you could not do this. The faculty has come to you because you have trained your sense of sight unconsciously while motoring.

Senses Improve with Use

This illustrates vividly an important consideration—that the senses improve with use. Moreover, the consciousness of possessing senses that are trained and so can be depended on to transmit accurately to the brain the impressions they receive, brings the self-confidence that is certain to lead on to greater achievements. Through the senses we obtain knowledge, and knowledge is power.

The carpenter reaches into his chest and without looking draws out the tool he wishes to use. Training of his sense of touch has taught him to differentiate unerringly between the feel of the handle of a chisel or some other tool.

To a layman the ledger of a commercial enterprise seems merely an unfathomable jumble of figures. To an accountant's trained eye, though, it tells a vivid story of the state of the concern's business health.

I might multiply examples of the sort without number—ordinary persons who excel their fellows by no natural equipment of talent, but who have acquired a high degree of useful skill simply through practice and the use of their senses. Typists, linotype operators, printers, musicians, draftsmen, artists, lawyers, surgeons, dentists, writers, workers in many fields of science—all these win success in the degree to which they develop one or more of the senses.

Touch, eyesight, and hearing probably are the senses most generally employed in the more familiar forms of human endeavor. But even the sense of smell, so little developed in the ordinary man and regarded by him as extremely unimpor-

(*Continued on page 146*)

HIGH SCHOOL COURSE IN TWO YEARS

YOU ARE BADLY HANDICAPPED if you lack High School training. You cannot attain business or social prominence. You are barred from a successful business career, from the leading professions, from well-paid civil service jobs, from teaching and college entrance. In fact, employers of practically all worth-while positions demand High School training. You can't hope to succeed in the face of this handicap. But you can remove it. Let the American School help you.

FIT YOURSELF FOR A BIG FUTURE This course, which has been prepared by some of America's leading professors, will broaden your mind, and make you keen, alert and capable. It is complete, simplified and up-to-date. It covers all subjects given in a resident school and *meets all requirements* of a High School training. From the first lesson to the last you are carefully examined and coached.

USE SPARE TIME ONLY

Most people *idle* away *fifty* hours a week. Probably you do. Use only one-fifth of your wasted hours for study and you can remove your present handicap within *two years*. You will enjoy the lessons and the knowledge you will gain will well repay the time spent in study.

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.....Accountant and Auditor	.....Sanitary Engineer
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.....Vocational Guidance	.....Wireless Radio
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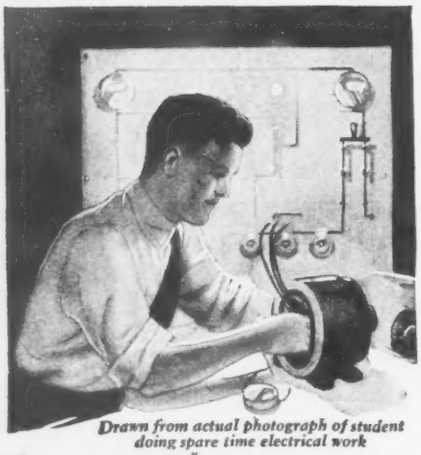
BOYS



Drawn from actual photograph of student doing spare time electrical work

Learn Electricity Make Big Money

How would you like to earn two or three dollars every evening after school and prepare yourself for a fine big job at the same time? Here's the opportunity of a lifetime for you fellows who like Electricity. Begin right now to prepare yourself for a regular man's size job in this fascinating field. Your chances for a big success are simply wonderful—the pay is big ($70 to $200 a week) and advancement comes swift and sure.

I will Train You at Home

With my easily learned, spare time Electrical Course I will train you at home like I have trained hundreds of other boys who are now big successful men. It will not interfere with your school work and you can earn more than the small cost of the course doing odd electrical jobs in your spare time. The Course pays for itself. I will show you how to get this work and how to do it. Some of my boy students make $10 to $15 a week this way.

Look What This Boy Is Doing

"Although the School term is coming to a close, and I am pretty busy with my examinations, I manage to keep up with my electrical studies and work.

"I guess I forgot to tell you I am now in business for myself. Am doing fine, but owe it all to you. If it had not been for your Course, I, being under age, could not have secured my license in this town. But I got it, and now have all the work I cando, averaging $20 to $30 a week, thru spare time work.

"I went out on a job tonight after school, on which I made $3 and brought home another on which I made $2.50—$5.50, for 4 hours' work and no material furnished by me."

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Send me your Free Outfit Offer, your big Electrical Book, Sample Lesson and particulars of your Electrical Course and Free Radio Course. This will not obligate me in any way.

Name.....

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This Coupon only for use of boys 15 years old or more.

Senses and Common Sense

(Continued from page 145)

tant so far as practical life is concerned, is used by many persons with such nice powers of discrimination that they not only make a good living, but often represent a vital link in the affairs of important industries. Tea tasters and testers of tobacco, foods, perfume, and beverages are only a few of those who utilize their trained sense of smell for their own benefit and the benefit of mankind.

But, you may say, how does all this apply to me? I have no wish to be a tea taster; it is not necessary for me to be able to estimate the thickness of materials by my sense of touch. I have a job. My work is all cut out for me.

Are you satisfied with that job? Don't you want to advance beyond it? There is no surer way for you to win promotion than by sharpening your senses through exercise.

If you are an office worker, for example, your sense of sight, your sense of hearing, several of your senses of touch are called into play. If you are a salesman, the same senses are used by you, but they must record their impressions with greater rapidity, because your work is less of a routine nature and you are constantly confronted with the necessity of solving new problems. If you are a manual worker, your senses of touch and sight are your bulwarks.

Conscious Use Trains the Senses

Learn to use these senses *consciously*. If you are looking at a thing, don't be satisfied to let that thing merely happen across your vision like a flash of light. See not only the thing itself—its size, shape, and color—but perceive and record the things surrounding it and their relation to the principal object.

Hear things, smell things, touch things, taste things in the same manner. Muster every sense you can in obtaining your impressions of an object, whether it is a column of figures in a ledger, a bolt of cloth of a new pattern, a blueprint drawing, a letter. Sense it in terms of other things with which you already are familiar. That is how the textile expert gages the value of materials, how the physician diagnoses the illness of his patient, how the machinist estimates the size of materials.

Learn to concentrate. These few words are the key that will unlock the wonderful storehouse of hidden powers in your mind.

If you will concentrate—on your pleasures and hobbies as well as on your tasks—your senses will train themselves. Your eyes are eager to see, your ears to hear, your other senses—25 or more—to perform their functions. They will develop if you will give them free rein by cultivating the habit of attention, a thing which because it offers so many advantages and so much profit to you, you should be prompted to do through the exercise of that greatest sense of all—common sense.

In next month's article Doctor Walsh will tell why we are what our habits make us, and how we can make and break our habits.

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Astronomy from the Cellar

(*Continued from page 41*)

give us no clear perception of the immense distances of the universe. Even to say that the sun is 93,000,000 miles away from us cannot convey a definite impression to the inhabitants of a planet only about 8000 miles in diameter, to whom an airplane journey of 3000 miles in a little more than a day seems almost incredible.

"How can we comprehend, then, that some of the stars of the Milky Way are more than one hundred thousand trillion miles away from us? Write this number on a piece of paper—100,000 followed by 12 ciphers—then try to picture the distance in terms of any earthly measurement, such as the breadth of the Atlantic Ocean. Of course, this gives you no comprehensible picture, but don't let that discourage you. Astronomers have been trying unsuccessfully for centuries to comprehend the awful distances of space. Even using the light year—an astronomical unit equivalent to about six million million miles—they are unable to picture understandably the sublime abysses of the worlds beyond.

"Astronomy has been my hobby for many years. I have pursued it unceasingly and with ever-increasing enthusiasm. There was a time when I believed there was no room in my life for anything but my work. I had taught myself to work constantly, every hour of the day.

"And then I made the important discovery that, commendable and important though industry may be, a man must have some other interest beyond his work.

The Telescope Opened His Eyes

"I took up yachting, and for several seasons it served its purpose of taking my mind from my business cares. Then, returning from a business trip to Europe one summer, I was unpleasantly shocked to find that my eyes no longer were able to pick up distant objects at sea as they formerly had been. Astronomers and others frequently had described to me the wonders of the heavens, and I decided then that if ever I was to see those wonders it was time to start. So when I landed in New York I bought a telescope.

"That instrument opened my eyes to the marvelous sights the heavens offered, and before I knew it I was unescapably bound to the fascinating study of astronomy. However, there were certain inconveniences connected with astronomical observation as I was conducting it. In the warm weather mosquitoes made it a somewhat heroic undertaking. In the fall and winter the cold winds chilled me to the bones. For self protection I built my underground observatory.

"In designing my observatory I was helped rather than hampered by my lack of technical knowledge of approved methods. I produced an observatory that suited my purpose, even though experts told me my methods were wrong. The observation chamber and the tunnel connecting it with my home were the first units completed. The tunnel carries water and heating pipes and electric wires

(*Continued on page 148*)

The hook-up that eliminates battery trouble

Some radio fans are still slaves to their batteries—lug them to service stations every time they need recharging—allow them to spoil many evenings' entertainment by running low.

Other fans—and they're quickly coming to be the vast majority—have found new economy and convenience in the GOLD SEAL HOMCHARGER, the world's best as well as its most popular rectifier. With it any radio or auto battery can be charged at home *overnight*—for a nickel. Simple, dependable, practically silent and absolutely safe. Beautifully finished in mahogany and gold. Approved by Underwriters. UNQUALIFIEDLY GUARANTEED. Over 150,000 now in use.

WHY PAY MORE—OR GET LESS?

Why buy a 2 or 3 ampere rectifier *without ammeter* requiring from 40 to 50 hours to charge your battery and costing twice as much to operate when, for the same price you can secure the genuine 5-ampere GOLD SEAL HOMCHARGER which does a better job in one-third the time and at half the cost. Fitted with high grade ammeter (eliminating guesswork) charging cable and battery clips—no extras to buy. For sale by all good dealers—$18.50.

Insist on the GOLD SEAL

Accept no substitute. No other charger is just as good. Insist on seeing our registered trade mark, the GOLD SEAL, on name plate and carton before purchasing.

RADIO FANS—ATTENTION!

FREE Ask your dealer for a free copy of the HOMCHARGER international list of broadcasting stations. Contains call letters, location, name and wave length of nearly every broadcasting station in the world.

DEALERS—JOBBERS!

Prepare for the big HOMCHARGER year ahead by writing today for a copy of our elaborate merchandising plans. In it is illustrated many attractive sales helps that will enable you to get your share of this business.

The Automatic Electrical Devices Co., 131 West Third St., Cincinnati, O.

Largest Manufacturers of Vibrating Rectifiers in the World

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Astronomy from the Cellar

(*Continued from page 147*)

to the observatory, and also provides a protected passageway.

"I have added to the observatory from time to time, until now I have a complete underground bungalow. The general layout and the size of the chambers, by the way, bear quite a striking similarity to the tomb of Tut-Ankh-Amen.

"Of course, having become tremendously interested in astronomy myself, I would like every one else to share my interest. It is most gratifying to me to know that 18 young men in Springfield have built their own telescopes, which they carry up the mountains to pursue astronomical observation.

"If people only knew the thrill and stimulation of a telescopic journey into other worlds, I am sure that when building their homes they would open a window to the sky before opening one to the street. Why have a window through which you can see only a dog fight or a few persons passing along the street when you might have one that will show you the vast depths of space and the stars and planets that lie there? There is no special background of education needed to undertake an intelligent study of astronomy in a human way; merely a capacity to appreciate and to make comparisons between things of tremendous magnitude and things that matter little.

"I was talking of astronomy to a young man whom I met on a train recently. I tried to make clear to him its wonderful interest and its thrilling possibilities, even for a layman. He listened to me, then said:

Schoolbook Astronomy Fooled Him

" 'Well, if that's astronomy, they fooled me badly when I was studying it in school! My book on astronomy had a lot of funny diagrams, and hazy pictures of stars with long names and some problems in spherical trigonometry. I hated it!'

"Many schools approach the teaching of astronomy from the wrong direction. Looking at a picture of a star bears about the same relation to seeing the star itself through a telescope as looking at a friend's picture bears to having the friend beside you, talking to you. See here."

Mr. Hartness turned an electric switch and immediately on the four walls of his study appeared four life-size pictures—a young woman, a little girl, an elderly man, and President Coolidge and his family. Mr. Hartness smiled and pointed to an odd instrument that stood beside his desk.

"A projector," he explained. "I find that by projecting the pictures of my family and friends in life size on the walls they are brought nearer to me than if I merely had their photographs framed and hung there. That illustrates in a way what I mean by the difference between seeing a star and seeing a picture of one.

"One of the valuable lessons we can take from astronomy is the necessity of staying on the job. Our earth and all the greater and lesser bodies beyond have been traveling unceasingly and unfailingly through the same orbits for millions and millions of years. They never falter in their course—an example that all of us well might follow!"

Recent Publications

A résumé of new books on science and invention

Constructive Conscious Control of the Individual, by F. Matthias Alexander. A companion volume to the author's earlier work, "Man's Supreme Inheritance," offering a constructive plan of life and education suited to the psychophysical development of man in his present environment of civilization. E. P. Dutton & Co.

The A B C of Atoms, by Bertrand Russell, F.R.S. A popular explanation of the new theory of the composition of matter, including a discussion of relativity, the wave theory of light, radioactivity and X-rays. E. P. Dutton & Co.

Everyday Mysteries—Secrets of Science in the Home, by Charles Greeley Abbot, D.Sc., Assistant Secretary of the Smithsonian Institution. A popular exposition of the scientific romance in everyday things—household appliances and the familiar phenomena of nature. Illustrated. The Macmillan Company.

Fundamentals of Radio, by James L. Thomas, formerly instructor in radio, U. S. Army. A review of the elementary principles of radio, and a non-technical explanation of the common radio circuits. Illustrated. D. Van Nostrand Company.

Masters of Science and Invention, by Floyd L. Darrow. Brief biographies of leading scientists from Galileo to Einstein. Illustrated. Harcourt, Brace & Co.

Great Inventions and How They Were Invented, by Charles R. Gibson, F.R.S.E. Illustrated. J. B. Lippincott Company.

Civilization and the Microbe, by Arthur I. Kendall, dean of the Northwestern University Medical School. Illustrated. Houghton Mifflin Co.

Essays of a Biologist, by Julian Huxley. Alfred A. Knopf.

Substance and Function, and Einstein's Theory of Relativity, by Ernst Cassirer. Translated by William Curtis Swabey and Marie Collins Swabey. The Open Court Publishing Company.

Elementary Zoology, by Oswald H. Latter, M.A. Illustrated. E. P. Dutton & Co.

Conservatism, Radicalism and Scientific Method, an essay in social attitudes, by A. B. Wolfe, professor of Economics and Sociology, University of Ohio. The Macmillan Company.

A Textbook of Physics (eighth edition) and *General Physics* (second edition), by W. Watson, revised by Herbert Moss, of the Imperial College of Science and Technology, London. Illustrated. Longmans, Green & Co.

Furnace Heating, by William G. Snow, revised and enlarged. U. P. C. Book Co.

America in Spitzbergen, by Nathan Hale Dole. Marshall Jones Company.

Reactionism, The Science of You, by John D. Boyle. G. P. Putnam's Sons.

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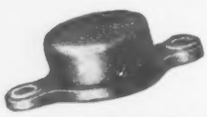

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Electrical Research Laboratories
Dept. F 2515 Michigan Avenue, Chicago

ERLA

Here Are Correct Answers to Questions on Page 53

1. Coal is impure carbon. Diamond is pure carbon, crystallized. That is, diamonds have their carbon atoms arranged in a definite form, rigidly fixed.

2. Because the blood clots. This is due to a material called fibrin, which is in the blood. As soon as blood gets out of its proper channels in the veins and arteries, this fibrin begins to form a solid clot or curd. This clot stops up the holes where the blood vessels were cut.

3. Food keeps on cooking as long as it is hot. The fireless cooker merely keeps it hot by preventing the loss of heat.

4. No. Our system of writing music is rather artificial. Out of the millions of possible notes, musicians have selected about 120. These selected notes make up the "scales." The songs of birds often contain notes that are not in this arbitrary system, not because they are higher or lower, but because they fall in between two of our selected notes.

5. The air on the earth holds the heat in, much as the glass of a hothouse holds the heat inside it. On a mountain the air is thinner and does not hold the heat in so well.

6. No. The number of times he comes up, if at all, will depend on his strength, on the weight of his body, on whether the water is salt or fresh, on the currents, etc.

7. When you are tired, two or three lumps of sugar dissolved in a glass of hot water and drunk on an empty stomach make an excellent stimulant. It is harmless except to those who cannot eat sugar.

8. It is the speed with which nerve messages can be passed around inside the brain. This is very great. The speed of nerve impulses, you remember, is 404 feet a second. Suppose you think of an idea so complicated that it requires 100 successive nerve messages from one side of the brain to another. All these 100 messages can be carried and the thought can be completed in less than a tenth of a second.

9. Because during millions of years the rains have been wearing down the land and carrying the dust and sand from it into the sea, and enough of it has accumulated to make the sea salty.

10. Compress it by a pump, like a tire pump. Remember that heat is really the motion of the atoms vibrating back and forth. When you compress air, you push its atoms closer together. This makes them hit against each other more often and makes them vibrate faster.

11. The record is made on a disk of soft wax. The sound from the musician enters the horn and makes the needle vibrate. This vibration causes the sharp point of the needle to make a series of tiny microscopic marks on the bottom of the wax groove in which it is running. These marks are an exact picture of the sound. When an ordinary hard record is made from this soft wax one, it contains these same marks. When you play it, your needle runs over these marks and they make it exactly reproduce the sound that made the marks on the wax.

12. It is a mixture of two chemicals with oxygen that produces the light. One of the chemicals is used up in the process and perhaps both are. It has been impossible to duplicate these chemicals.

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More Money Making Opportunities on pages 8 to 25

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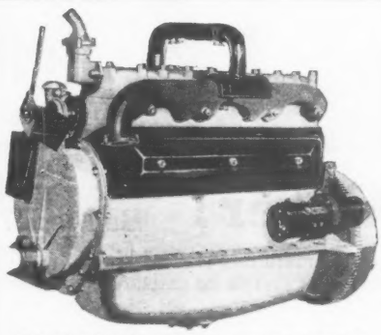
It is actually a process for tuning up all the mental faculties and making them work together for the greatest self-development possible to each Pelmanist.

That this wonderful system is both practical and fascinatingly easy to learn is proved by the thousands of enthusiastic endorsements that the Pelman Institute is constantly receiving from students of Pelmanism.

Here is what Mr. Ray P. Hovey, of San Pedro, California, writes:

"I have put the Pelman course into practice by going after the things I needed to achieve advancement. I have built a new home for myself and family; have developed a taste for study, and broader lines of thinking and reading; and have secured a position much more adapted to my best experience and capabilities. I feel a thousand times repaid for starting the course."



YOUR BRAIN IS LIKE THIS ENGINE

Check right now the "cylinders" where you feel that your "compression" is poor

☐ Purpose	☐ Observation
☐ Will Power	☐ Imagination
☐ Concentration	☐ Memory

Mr. A. Gillespie, Vice-President, of Cluett, Peabody & Company, manufacturers of Arrow Collars, says:

"Had I known at 30 what Pelmanism has taught me since 50, many things in my life that were difficult would have been easy. If you have but a spark of ambition or if you are merely dissatisfied with the returns you are getting from your outlay of effort, subscribe for the Pelman course."

And Mr. C. B. Claflin, a merchant in Philadelphia, Pennsylvania, sums it all up in the words:

"I have practically revolutionized my life by taking this course."

The Pelmanist as a business man is never far from opportunity. He sees it in places where the average eye sees nothing. Proper training has sharpened his observation and all his other mental faculties. He has a purpose in life and he *knows* he can achieve his aim. His concentration and imagination are strong; his will is powerful—in a word, he is "captain of his soul!"

Learn the "team-work" of the mind

Lack of space prevents mention of all the benefits Pelmanism can bring into your life, as easily and certainly as the sun rises. But the Pelman Institute has prepared a free book that will really startle and amaze you. It shows how and why Pelmanism is the only system of teaching ever devised for developing *all* the mental powers at the same time.

Whether this brief glimpse of Pelmanism has attracted you or not, whether you feel that you are weak or lacking in some valuable mental attribute, or not—you should at least send for this remarkable record and outline of Pelmanism—its actual achievements, and its boundless possibilities.

Send Now for This Free Proof

Pelmanism actually gives its students "New minds for old"—and it does it in three to six months, through a method so novel, fascinating and easy that you look forward to each new lesson as you would to a pleasant evening in the theatre.

You do not obligate yourself in any way by sending the coupon below, but it will bring you a copy of the astonishing free book that explains Pelmanism from start to finish, and gives a wealth of the most convincing, voluntary letters from Pelmanists, showing how this remarkable method revolutionized their lives and fortunes, meanwhile increasing their earning capacity.

One of our most successful students writes that he sent for this free book "through mere curiosity." But he also writes that Pelmanism "has made another man of me," and that mailing the coupon from one of our advertisements was "the wisest act of his life."

It will pay *you* to find out about Pelmanism, too, even though you think now that it is just another self-improvement course. A healthy curiosity about Pelmanism has often opened the door to entirely unexpected, immensely valuable benefits. Send the coupon at once, while you feel like doing it. No salesman will call upon you. You risk nothing, and may have more to gain than you can possibly realize now.

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I want you to show me what Pelmanism has actually done for nearly a million people. Please send me your free book. This places me under no obligation whatever.

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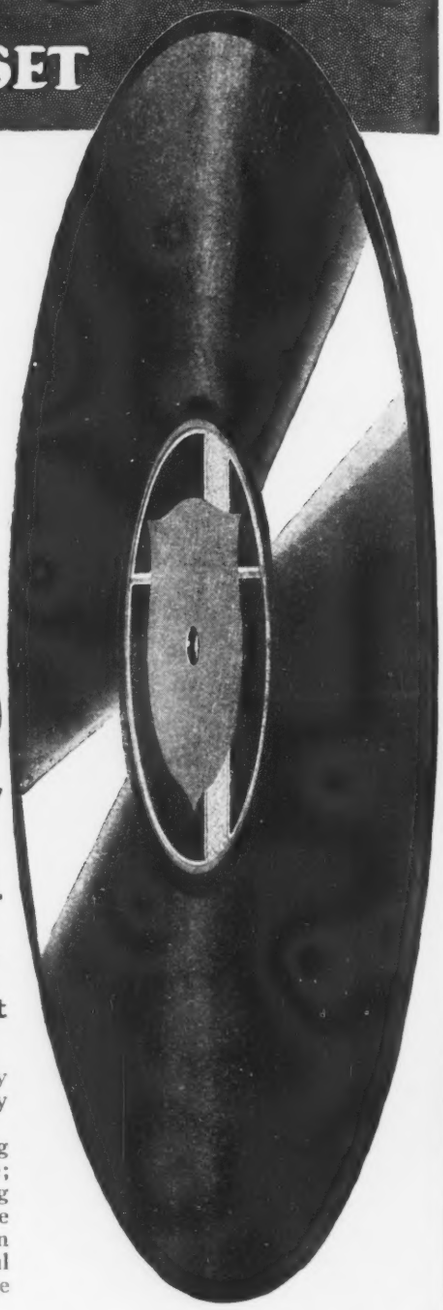
on pages 8 to 25

JUST OUT!

THE NEW "NATIONAL" SET



You Hear These Wherever You Go!

These Great New Fox Trots

Arcady
An Orange Grove in California
Roses of Picardy
Sittin' In a Corner
Linger Awhile
When It's Night Time In Italy, It's Wednesday Over Here
Mamma Loves Papa, Papa Loves Mamma

These Wonderful New Waltzes

Sleep
Cielito Lindo (Beautiful Heaven)

These Great New Song Successes

I'm Sitting Pretty In a Pretty Little City
If the Rest of the World Don't Want You
I'm Going South
You're In Kentucky, Sure As You're Born
When Lights Are Low
So I Took the Fifty Thousand Dollars
Stay Home, Little Girl, Stay Home

16 Most Popular Fox Trots Songs and Waltzes $2.98

On Eight 10-INCH Double Face Records FOR ALL

A Sensational Offer! How Can It Be Made?

Here is a complete library of the newest and biggest hits in the music world. 16 wonderful songs, fox trots and waltzes that are sweeping the country, the most popular songs of TODAY, played by wonderful orchestras, sung by accomplished artists. The most wonderful phonograph record bargain you have ever seen, made possible by quantity production and direct selling. Every record 10-inch size. Every record guaranteed manufactured of highest quality material, and to be satisfactory in every way.

These are the songs that are being sung, whistled and played everywhere; fox trots and waltzes that are being danced to all over the country; that are right now, today, the biggest hits on Broadway. Do not miss this wonderful opportunity; remember that these are brand new 10-inch records.

NATIONAL MUSIC LOVERS, Inc.
Dept. 1033, 218 West 40th Street,
New York

Please send me for 10 days' trial, your collection of 16 very latest songs, fox trots and waltzes, on eight double-face ten-inch records. I will pay the postman only $2.98 plus delivery charges on arrival. This is not to be considered a purchase, however. If the records do not come up to my expectations, I reserve the right to return them at any time within 10 days and you will refund my money. (Outside U. S., $3.50 cash with order.)

Name.....

Address.....

City..... State.....

If you like the great songs from Grand Opera you may also care to have four of the most popular airs ever written, **La Donna e Mobile** from Rigoletto; Medley of Pinafore songs; **Habanera** from Carmen; and **Soldiers' Chorus,** from Faust. All beautifully sung by great artists, with full orchestra. If you care to have these Grand Opera Songs, in ADDITION to the set listed above, place an X in ☐ square at left. The price is only 89c for all four selections. SOLD ONLY with the set advertised above—not sold separately.

Send No Money

Try these wonderful records in your own home for 10 days. Note the beauty of recording, the clearness of tone, the catchiness of the tune, the wonderful volume of music. See how durable and smooth these records are. You will wonder how we can give such a tremendous bargain. Quantity production, and selling direct-from-factory-to-you; that is the whole secret. This is the greatest selection of hits ever put out at one time, and this low price makes it the biggest record bargain ever offered. Send no money now. Just mail coupon or letter. Give the postman $2.98 plus the few cents delivery charges. Then play all the records on your own machine. If not pleased, return the records and we will refund your money plus postage both ways. This offer may never be repeated, so mail coupon at once

National Music Lovers, Inc.

Dept. 1033, 218 West 40th Street, New York City

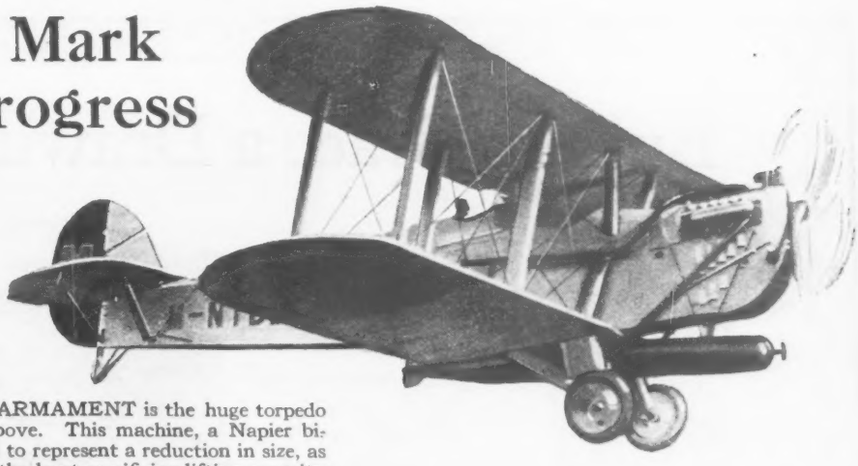
sible to each Pelmanist.

The Pelmanist as a business man is never far from

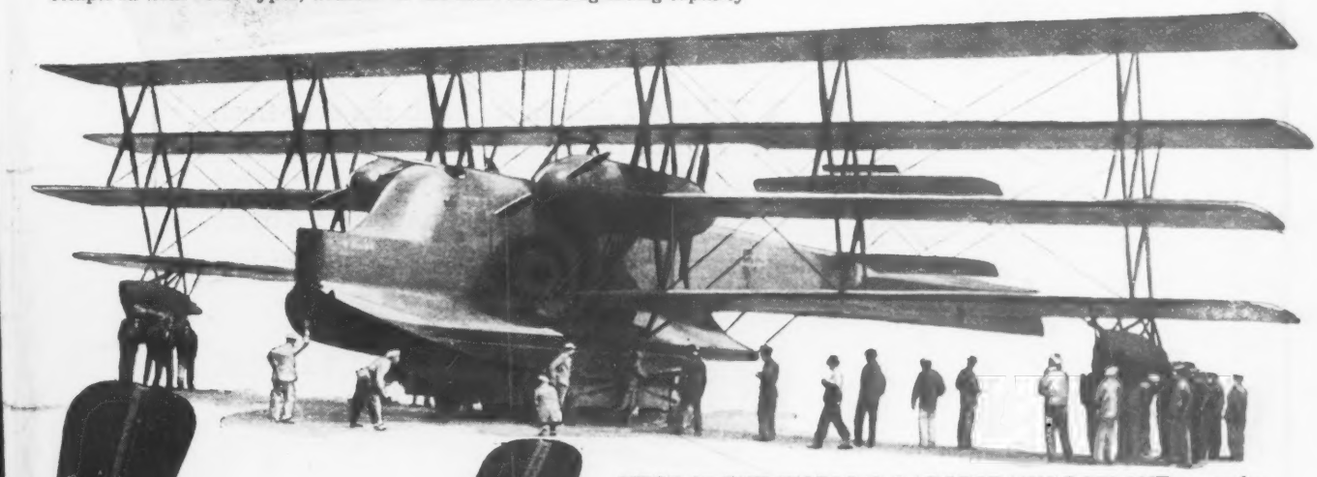
City State

Machines that Mark New Aerial Progress

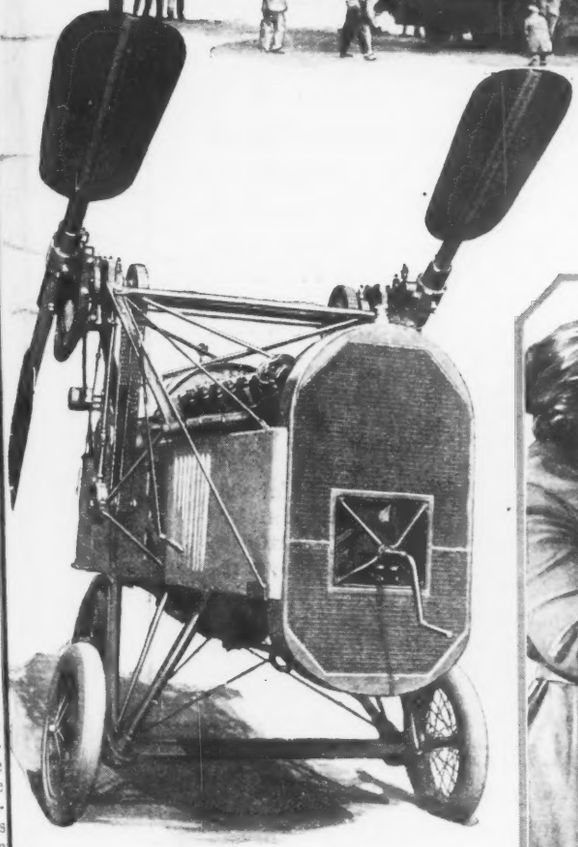
Giant Airplanes and Odd Helicopters to Conquer the Skies



THE LAST WORD IN NAVAL AIR ARMAMENT is the huge torpedo carrying airplane shown in full flight above. This machine, a Napier biplane built for the British navy, is said to represent a reduction in size, as compared with other types, without in the least sacrificing lifting capacity



HERE IS THE WORLD'S LARGEST HYDROPLANE, recently completed at St. Raphael, France. The machine is a huge double biplane weighing 10 tons and driven by four motors of 1000 horsepower each. The great streamlined body forms a spacious air coach handsomely furnished for passenger transportation. This body is built on a broad pontoon capable of riding the waves in the roughest weather. Note the unusual arrangement of the four wings in pairs



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THE LATEST CONTESTANT for the $250,000 British Air Ministry prize, offered for a practical vertically rising machine, is the Omnivator, pictured above. Its two side propellers are designed to imitate the movement of a bird's wings. The inventor, E. P. Johnson, of Chicago, claims it will fly backward or forward

A HELICOPTER BUILT ON AIRPLANE LINES has been designed by William J. Beach, author-inventor, of Australia and New York City, who is shown above demonstrating a small model of his invention. The upward movement of the strange machine is said to be produced by revolving planes acting on a series of four shutter-like planes that stabilize the machine

Built to Grace a Drawing Room

Grebe Broadcast Receiver Type CR-12. A 4-tube Receiver combining Regeneration and Tuned R. F. $175.00
(Accessories extra)

"There is no calamity greater than discontent; no vice more sickening than covetousness."
—*Lao Tzu.*

Contentment comes with possession of the best. Covet not thy neighbor's Grebe Receiver, acquire one for thyself.

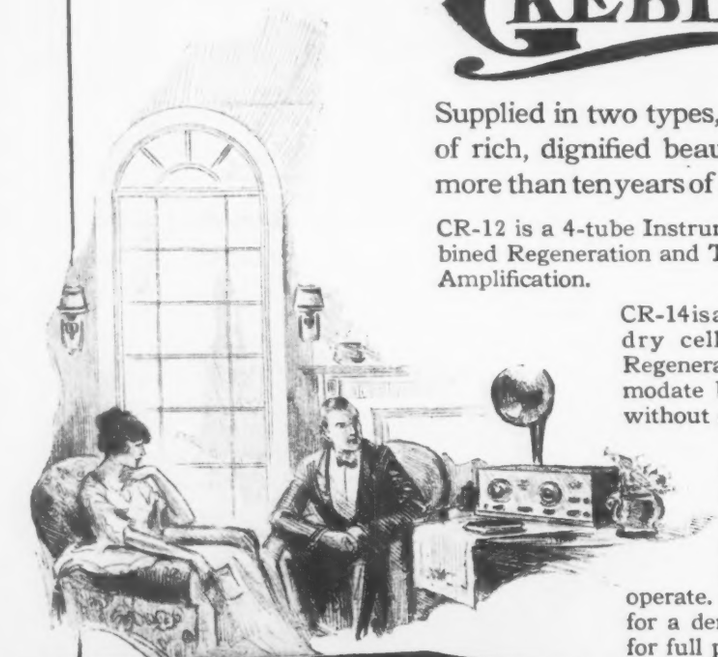
Doctor Mu

WHAT delight for all in the ever-fresh programs during the long, wintry evenings to come. Today's broadcasting better than yesterday's; tomorrow's more fascinating than today's. Tune in on this realm of entertainment, with a

GREBE Broadcast Receiver

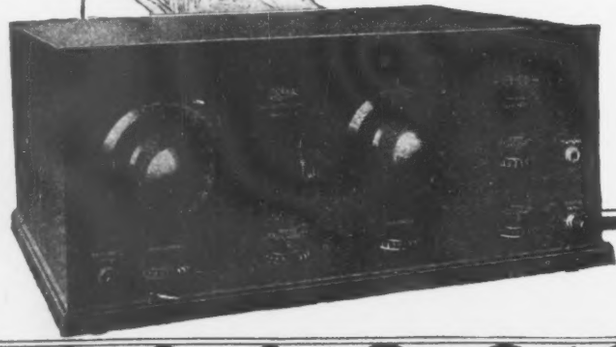
Supplied in two types, each an Instrument of rich, dignified beauty—the product of more than ten years of skillful development.

CR-12 is a 4-tube Instrument in which are combined Regeneration and Tuned Radio Frequency Amplification.



CR-14 is a popularly-priced 3-tube dry cell Receiver employing Regeneration. The sockets accommodate UV-199 or C-299 tubes without adapters.

Both have beautiful walnut cabinets, employ concealed dry batteries and are extremely simple and economical to operate. Ask your quality dealer for a demonstration, or write us for full particulars.



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